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NEW SPECIES OF FLEAS (Siphonaptera) FROM CERRO POTOSI, MEXICO, WITH NOTES ON ECOLOGY AND HOST PARASITE RELATIONSHIPS

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Abstract: Twenty-eight species of fleas were collected in the State of Nuevo Leon, Mexico during spring and fall of 1964. Descriptions of 2 species, *Anomiopsyllus nidiophilus*, n. sp. and *Phalacropsylla hamata*, n. sp., and the ♂ of *Foxella mexicana* (I. Fox, 1939) are included. Evidence is presented, in the form of charts and graphs, which indicates that elevation and season are likely of greater significance in the distribution of fleas than sex of host, at least among small rodents which produce several litters per year.

According to Koestner (1944), Cerro Potosi is the highest peak (3800 m) in the Sierra Madre Occidental Range and lies about 65 km west of Linares in the Municipio de Galeana, Nuevo Leon, Mexico. During the spring (18 April through 6 May) and fall (11 through 24 September) of 1964 we collected nearly 1500 rodents and their nests at the base of, or on, Cerro Potosi. Most of the specimens were collected above 3000 m elevation but an attempt was made to obtain material at several collecting sites from 1680 m elevation to the top of the mountain. We selected Cerro Potosi as a collecting site because the topographical features of the landscape, the ecological characteristic of the mammalian flea fauna, and the interrelationship of the indigenous human population with some of the rodent species make this an interesting study area.

Twenty-eight species of fleas were collected from rodent hosts and their nests. Four species are new to science and the males of *Foxella mexicana* (I. Fox 1939) and *Rhadinopsylla mexicana* (Barrera 1952) are as yet undescribed. Current studies of the flea fauna of Mexico are being conducted by Dr Robert Traub and Dr Alfredo Barrera. They are preparing taxonomic papers in which 2 species, *Hystrichopsylla* sp. and *Strepsylla* sp., are being described; therefore, we will refer to these species only briefly. In addition, several hundred specimens belonging to the genus *Pleochaetis* Jordan, 1933 will be studied by them as a part of a much of needed generic revision. They will also describe the male of *R. mexicana*. Included in this paper are: descriptions of 2 species, *Anomiopsyllus nidiophilus*, n. sp., and *Phalacropsylla hamata*, n sp., as well as the male of *Foxella mexicana*; comments relative to the epidemiological significance of some of the host-parasite relationships; and an attempt to show the influence of elevation, season and sex of host on the abundance and occurrence of those species of fleas which were collected in significant numbers.

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Cediopsylla simplex (Baker)

Pulex inequalis var. *simplex* Baker, 1895, Can. Ent. **27**: 164. Type material ex *Lepus*; Michigan.

Cerro Potosi Material: 15♂♂ and 15♀♀ ex (3) *Sylvilagus floridanus*, 2400–2700 m elevation; 26.IV–3.V.1964.

Remarks: Our specimens appear to be *C. simplex* but possess some characteristics of *C. spillmanni* Jordan, 1930. The clasper of the ♂ has 12–14 bristles as in *C. simplex*, sternum VIII is very broad as in *C. spillmanni*, but the tip does not bend abruptly. The genal comb is rather widely separated from the eye, somewhat as in *C. inequalis*. In the ♀ the angle of the frons is above the middle as in *C. simplex*. It is quite possible that additional specimens collected at several points between Mexico and Colombia would reveal a cline with *C. simplex* at the northern extreme and *C. spillmanni* at the southern end.

Pulex simulans Baker

Pulex simulans Baker, 1895, Can. Ent. **27**: 65, 67.—Smit, 1958, J. Parasitol. **44** (5): 523–26, fig. 1. Description of ♀ (and probably ♂) based on specimens from *Didelphis marsupialis*, likely collected at Devil's River, Texas. Male specimens apparently have been lost and Smit (1958) has designated one of the syntypes (in Tring collection) as lectotype.

Cerro Potosi Material: 129 specimens ex (17) *Cynomys mexicanus* Merriam, 1892, 1820–1920 m elevation; IV., V. & IX.1964; 1♀ ex *Microtus mexicanus subsimus* Goldman, 1938, 3200 m, IX.1964.

Occurrence of *Pulex simulans* on *Cynomys mexicanus* according to season and sex of host follows:

Host	April/May			September	
	♂	♀	Sex Unknown	♂	♀
Total Hosts (*Cynomys mexicanus*)	5	5	3	2	2
Positive Hosts	3	1	3	2	2
No. of Specimens of *P. simulans*	31	32	21	30	15
Flea Index	10.3	32	7	15	7.5

Remarks: Smit (1958), states, "Although *P. simulans* seems to occur on a wide variety of mammals, it is perhaps primarily a parasite of prairie dogs (*Cynomys*), but it is also commonly found on skunks (*Mephitis*), ground squirrels (*Citellus*), opossums (*Didelphis marsupialis*), grey fox (*Urocyon*), coyote (*Canis latrans*), and deer (*Odocoileus*)." Wilson (1966) summarized recorded host data and to the hosts listed by Smit adds *Vulpes fulva*, *Vulpes macrotis arsipus*, *Vulpes velox velox*, *Taxidea taxus*, *Spilogale putorius phenax*, *Canis familaris*, *Mus* sp. and *Homo sapiens*. Our finding a single specimen on *Microtus* then is not unusual. However, it does suggest some intercourse between 2 groups of animals, 1 of which (*Cynomys*) is highly susceptible to plague and the other (*Microtus*) somewhat more resistant.

In the spring, 46.4% of all fleas collected from prairie dogs were *P. simulans* and 53.6% were *Opisocrostis hirsutus*. In the fall 93.7% of the fleas were *P. simulans* and 6.3% were *O. hirsutus*. *P. simulans* was equally abundant in spring and fall and the change in

ratio was due to a decline in the number of *O. hirsutus* collected in the fall. The number of *P. simulans* collected did not appear to be influenced by the sex of the host.

Host records have been discussed by Smit (op. cit.) and Wilson (op. cit.); geographic distribution by Wilson (op. cit.) and Tipton & Mendez (1966). *P. simulans* is a polyhaematophagous parasite, but we believe the optimal host to be the prairie dog (*Cynomys*). We consider *P. irritans* to be temperate in distribution, both in altitude and latitude. It appears likely that the geographic area optimal for *P. simulans* is Central America and Mexico but it has become well established in other areas of the world with similar ecological characteristics.

Polygenis gwyni (C. Fox)

Rhopalopsyllus gwyni C. Fox, 1914, Hyg. Lab. Bul. **97**: 5, 10, 11. Type material ex *Epimys norvegicus* (=*Rattus norvegicus*); Brunswick, Georgia.

Cerro Potosi Material: 14♀♀ and 4♂♂ ex (4) rodent nests: 1♀, 3350 m elevation; the remainder from 1740 m; IV.1964.

Remarks: In Panama *Polygenis dunni* is frequently found associated with spiny mice. Koestner (1941) collected *Liomys irroratus alleni* (Coues) in a house at Galeana and in another nearby village. Further collecting of this rodent may indicate a relationship with *P. gwyni* in the Cerro Potosi area. Our specimens are difficult to study because of some mutilation resulting from being in dried nests and, in addition, they are somewhat overcleared.

Anomiopsyllus nidiophilus Tipton and Mendez, new species Fig. 1–6.

Diagnosis: Similar to *Anomiopsyllus martini* Holland, 1966 in having 4 spiniforms on the movable finger of the clasper (F). All other described species have either 2 or 3 spiniforms on F. *A. nidiophilus* n. sp. may be distinguished from *A. martini* on the basis of the arrangement of the spiniforms on F, the reduced number of spiniforms on the apical portion of the distal arm of the 9th sternum and in other details of the modified abdominal segments and especially the aedeagus.

♂. *Head*: (fig. 1). Anterior margin evenly rounded, interrupted by frontal tubercle. Pre- and postantennal area with micropores evenly distributed. Preantennal area with 2 dermal pits, single row of 3 bristles, middle bristle shortest. Maxillary lobe acuminate, reaching apex of segment 2 of labial palpus. Maxillary palpus extended beyond apex of forecoxa, with 2nd segment 1.5× longer than 1, last 2 segments of subequal length; each segment with several short marginal and submarginal bristles in irregular pattern. Labial palpus reaching trochanter; with segment 1 wider than others, segment 2 smaller than 1, segment 3 slightly larger than 2; last segment largest, exceeding length of 3. Antennal shape cup-shaped, with 2 or 3 short bristles distributed on anterior margin, 2 on posterior margin; antennal pedicel asymmetrical, with 3 or 4 short bristles at anterior margin, about same number at posterior margin; antennal clava with reduced fringe on each segment, 2 or 3 submarginal bristles, about 4 short apical bristles. Postantennal area with 3 dermal pits, irregular row of 3 or 4 bristles along dorsal margin of antennal fossa. Usually 1 long bristle flanked by 2 much shorter bristles, 4th bristle in row longest. Posterior margin of head with single row of 3 short, equal bristles preceded by solitary dorso-marginal bristle.

Thorax: Pronotum with single row of 3–4 short bristles at each side with intercalary setae. Sternopleuron with caudal margin irregular, indented. Mesonotum and metanotum each with single row of about 6 bristles. Mesepisternum with 5 short bristles. Mesepimere with 2 equal bristles near ventral margin. Metepisternum with 7 short bristles, row of 3 near pleural rod,

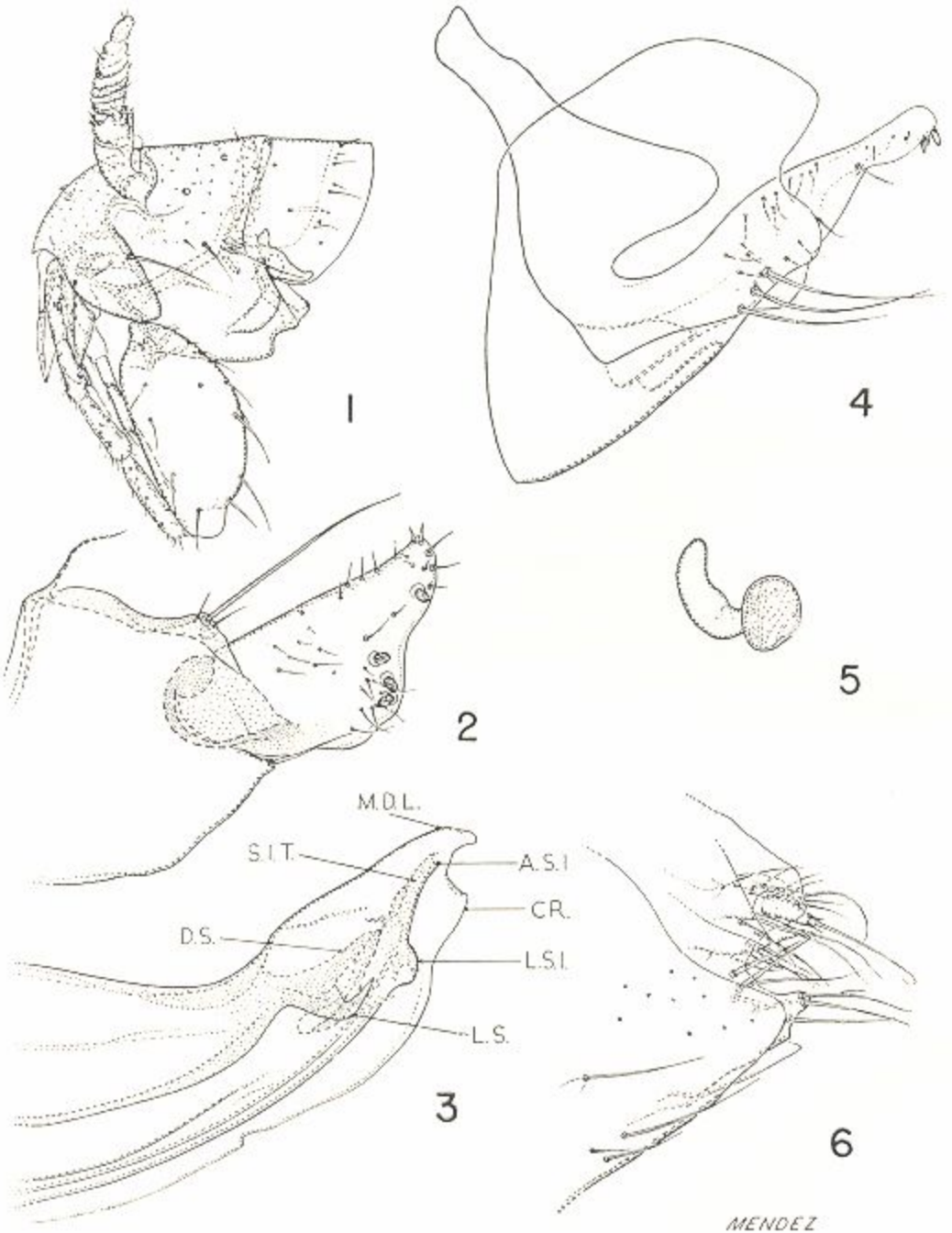


Fig. 1–6. *Anomiopsyllus nidiophilus*, n. sp.: 1–4, HOLOTYPE ♂: 1, head, prothorax and procoxa; 2, process and immovable finger of clasper; 3, apex of aedeagus; 4, 8th and 9th sterna; 5–6, ALLOTYPE ♀: 5, spermatheca; 6, terminal segments, anal stylet and ventral anal lobe.

other 4 in meso-ventral area. Metepimeron with 2 bristles near anterior margin. *Legs*: Procoxa with several bristles, primarily along posterior margin. Meso- and metacoxae with setation similar to procoxa. All trochanters with 1 or 2 anteromarginal bristles, minute setae on posterior margin; anteromesal surface with small patch of minute setae. Profemur with series of dorso-marginal bristles; usually 2 bristles on inner surface, few scattered bristles along anterior margin. Meso- and metafemora with arrangements of bristles essentially same as profemur. All tibiae with irregular pattern of strong bristles near dorsal margin. Pro- and mesotarsal segments I–IV with bristles limited to apical area. Metatarsal segments I–II with patterns of 3 bristles arranged in lateral series; apical bristles, especially dorsal ones, larger than others; apical bristles of segment II reach claw of 5th tarsal segment. Last tarsal segments of all legs with 4 pairs of lateral plantar bristles.

Abdomen: Tergum I with 2 marginal spinelets on each side, preceded by single row of bristles; tergum II with only 1 marginal spinelet and 1 row of bristles; terga II–VIII bearing 1 row of bristles. Non-modified sterna with pair of apical bristles per side. Tergum VIII with 1 long antesensilial bristle inserted between 2 shorter bristles.

Modified abdominal segments: Sternum VIII (fig. 4) slightly longer than broad, covering much of sternum IX; dorso-caudal margin strongly sinuate, forming deep sinus, with 3–4 submarginal setae near caudo-ventral angle. Sternum IX (fig. 4) with both arms of about equal length; proximal arm somewhat triangular; distal arm with subapical constriction, bearing solitary bristle; apex slightly dilated, with 3 spiniforms on ventrosubapical margin, 3–5 small mesal bristles; arm widens proximad of constriction, series of small bristles near anterior margin, lateral area with 5–6 small bristles. Immovable process of clasper (fig. 2) almost as long as broad, with anterior margin mildly curved, almost straight; dorsal margin sinuate, forming dorsal lobe with long apical seta which reaches apex of movable finger of clasper, inserted between 2 short bristles of equal length; ventro-caudal margin sinuate, provided with single acetabular bristle; manubrium extremely short, claw-shaped. Movable finger of clasper (fig. 2) broad, subtriangular, with maximum breadth at middle, tapering distally into subacuminate apex; with 4 submarginal spiniforms, 1 near apex, remaining 3 in close proximity to each other near caudoventral angle; with several marginal, submarginal and mesal bristles as illustrated. *Aedeagus*: Aedeagal apodeme 2× the length of aedeagus proper, separated from this structure by well defined neck. Aedeagus proper (fig. 3) relatively simple, with dorsal margin very shallowly sinuate, terminating with claw-shaped median dorsal lobe (M.D.L.). Proximal spur absent. Crochet (CR) reduced to small, inconspicuous, subacuminate process. Sclerotized inner tube (S.I.T.) well defined, with apex (A.S.I.) slightly curved, prominent lateral sclerotization (L.S.I.) lobe-like. Lateral sclerite (L.S.) upcurved, strongly sclerotized, with boomerang shape, facing elongated, angular, dorsal sclerite (D.S.).

Allotype ♀: Sexual dimorphism slight except for modified abdominal segments, larger size, apical bristles of metatarsal segments I–II reduced in length. *Modified abdominal segments*: Sternum VII (fig. 6) with apical margin shallowly sinuate, with 4 bristles varying in size arranged in irregular row near ventral margin. Apical margin of tergum VIII indented, forming deep sinus, ventral lobe with apical and subapical bristles moderately long; similar bristles inserted near sinus. Dorsal anal lobe as in other species of genus, bearing group of marginal and submarginal dorsal bristles. Anal stylet moderately long and narrow, about 3× as long as wide. Gradually tapering towards apex, bearing long apical bristle between 2 shorter subapical bristles. Ventral anal lobe angular, bearing several marginal, submarginal bristles plus 1 mesal bristle. Spermatheca (fig. 5) with subglobular head; tail narrow, about 2× as long as broad, with constriction at base, widest slightly before middle, gradually tapering distally.

Type Material: Holotype ♂ and allotype ♀ ex nest of woodrat (probably *Neotoma albigula leucodon*), Cerro Potosi, Nuevo Leon, Mexico, elevation 3350 m, collected by V. J. Tipton et al., 24.IV.1964. Paratypes: 166♀♀, 38♂♂, same data as above; 6♀♀, 6♂♂ ex *Neotoma albigula leucodon*, same locality as above but with dates and elevations as follows: 2♀♀, 5♂♂, 21.IV.1964, 3450 m; 2♀♀, 1♂, 23.IV.1964, 3030 m; 1♀, 11.IX.1954, 3140

m; and 1♀, 23.IX.1964, 2990 m. Holotype ♂ and allotype ♀ are deposited in the U. S. National Museum. Paratype specimens are deposited in the British Museum (Natural History); Canadian National Collection; Rocky Mountain Laboratory at Hamilton, Montana; Escuela Nacional de Cienias Biologicas (I. P. N.), Mexico, D. F.; Brigham Young University, Provo, Utah; Gorgas Memoral Laboratory, Panama, Bishop Museum, and in the collections of Robert Traub and the senior author.

Hystrichopsylla species[3]

Cerro Potosi Material: 36 specimens as follows:

Host	April/May			September	
	No. of Positive Hosts	♂	♀	♂	♀
P. melanotis	16	2	7	2	6
P. difficilis	1	0	0	1	3
N. albigula	1	0	0	0	2
Nests		4	9	0	0
Total		6	16	3	11

Remarks: Our specimens are too few in number to establish firmly distributional trends relating to season or elevation. Our 36 specimens were collected from 2900 to 3660 m elevation and most of them (64%) in the spring, even though considerably more hosts were collected in the fall.

Stenoponia ponera Traub and Johnson

Stenoponia ponera Traub & Johnson, 1952, J. Parasitol. **38** (1): 12–18. Holotype ♂, allotype ♀, 6♂♂ and 2♀♀ paratypes ex *Peromyscus boylii*; 11 km N of Pinos Altos County, New Mexico; 2100 m; 12.X.1950; 2 additional ♂♂ paratypes with same data except ex *Eutamias dorsalis*; 1♂ paratype ex *Peromyscus* sp., Laguna del Progresso, Durango, Mexico; 27.VI.1950; 1♀ paratype in collection of spiders received by American Museum of Natural History; Mexico D. F., Mexico, XII.1954.

Cerro Potosi Material: 271 specimens as follows:

Host	April/May			September		
	No. of Positive Hosts	♂	♀	No. of Positive Hosts	♂	♀
Peromyscus melanotis	39	27	28	112	74	95
Peromyscus d. difficilis	9	5	10	14	6	8
Peromyscus species	9	10	5	0	0	0
Microtus mexicanus subsimus	0	0	0	2	0	2
Nests	1	0	1	0	0	0
Total		42	44		80	105

3. To be described by Traub and Barrera.

Occurrence of *Stenoponia ponera* Traub & Johnson on *Peromyscus melanotis* J. A. Allen & Chapman according to elevation, season and sex of host:

	Elevation in thousands of feet (meters in parentheses): 8–9 (2.4–2.7)	9–10 (2.7–3.1)	10–11 (3.1–3.4)	11–12 (3.4–3.7)	12–12.5 (3.7–4.8)
Spring					
Female *P. melanotis*	0	4	102	17	16
Positive female *P. melanotis*	0	0	6	1	0
Percent of female hosts positive	0	0	5.9	5.9	0
Number of *S. ponera*	0	0	7	1	0
Flea Index	0	0	1.16	1	0
Male *P. melanotis*	0	6	159	34	37
Positive male *P. melanotis*	0	3	25	4	0
Percent of male hosts positive	0	50	15.7	12.3	0
Number of *S. ponera*	0	4	38	5	0
Flea Index	0	1.31	1.52	1.25	0
Fall					
Female *P. melanotis*	1	2	202	12	31
Positive female *P. melanotis*	0	0	45	4	0
Percent of female hosts positive	0	0	22.2	33.3	0
Number of *S. ponera*	0	0	71	7	0
Flea Index	0	0	1.57	1.75	0
Male *P. melanotis*	1	5	263	21	52
Positive male *P. melanotis*	0	0	61	2	0
Percent of male hosts positive	0	0	23.1	9.5	0
Number of *S. ponera*	0	0	89	2	0
Flea Index	0	0	1.45	1	0

Remarks: More than 82% of the specimens were collected from *P. melanotis* (88% if *Peromyscus* sp. is considered to be *P. melanotis*). Positive hosts averaged between 1 and 2 fleas each. In the spring there was a significantly higher percentage of ♂ hosts positive than ♀ hosts (15.8% compared with 5.9%), while in the fall there was only a slightly higher percentage of ♂ hosts positive than ♀ hosts (23.3% compared with 22.2%). Most of our specimens (91.5%) were collected between 3050 and 3350 m elevation, and all specimens (except 5) were collected between 2990 and 3450 m. The highest rate of infestation occurred on ♂ hosts (*P. melanotis*) in the fall at 3050–3350 m.

In the ♂ aedeagus of our specimens the crochet is shaped like a thumb and curving index finger with both the thumb and finger more slender and acuminate than indicated by Traub & Johnson (1952). Also the apex of the proximal arm of the 9th sternum is not so robust and the beak is more pronounced. In the ♀ the outline of the 7th sternum is variable but essentially as figured by Traub & Johnson. The shape of the spermatheca is highly variable and is dependent upon its orientation in the abdomen of the flea.

Epidedia wenmanni (Rothschild)

Ctenophthalmus wenmanni Rothschild, 1904, Nov. Zool. **11**: 642. Type material (♂, ♀) ex *Peromyscus leucopus* (=*P. maniculatus* ssp.) and *Neotoma cinerea*).

Cerro Potosi Material: 191 specimens as follows:

Host	No. of Positive Hosts	April/May ♂	April/May ♀	September ♂	September ♀
P. melanotis	103	33	70	9	11
P. difficilis	5	2	4		
Peromyscus sp.	8	4	6		
M. mexicanus subsimus	15	8	14	1	3
M. musculus	1	0	2		
Nests	7	12	12		
Total		59	108	10	14

Occurrence of *Epitedia wenmanni* according to season and sex of host:

	April/May ♂	April/May ♀	September ♂	September ♀
Peromyscus melanotis (total collected)	236	139	342	248
Number of *P. melanotis* with *E. wenmanni*	60	24	12	7
Percent of *P. melanotis* with *E. wenmanni*	25.4	17.2	3.5	2.8
Percent of *M. mexicanus subsimus* with *E. wenmanni*	27.0	17.3	4.0	4.5

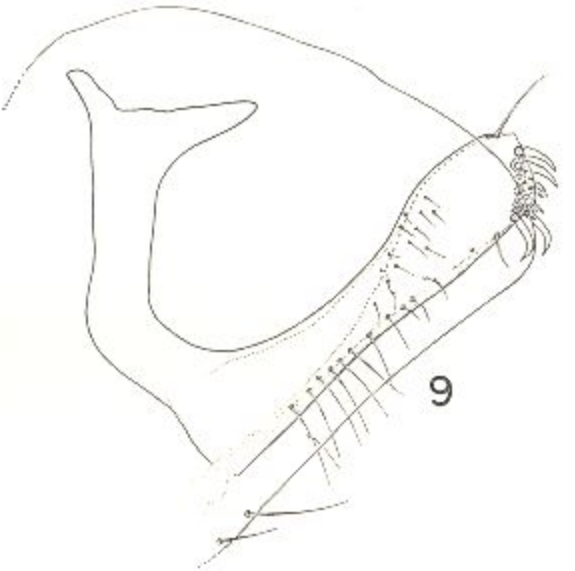
Remarks: According to Holland (1949) *E. wenmanni* is widespread throughout North America and has been collected as far south as New Mexico. (The senior author has collected several specimens in Big Bend National Park, Texas.) It has been found most frequently associated with species of *Peromyscus*. At Cerro Potosi the flea index varied little from 1 flea per positive host, regardless of sex of host, season or elevation. However, the majority of our specimens (87.5%) was collected in the spring and a much higher percentage of hosts was parasitized in the spring than in the fall. Most of our specimens (64%) were collected from *P. melanotis* (70% if we consider *Peromyscus* sp. to be *P. melanotis*). All specimens were collected above 3050 m elevation except 10 specimens from rodent nests (2900 m) and 2 specimens from *Mus musculus* (1830 m). The highest percentage of positive hosts (23.8) occurred at 3350–3660 m.

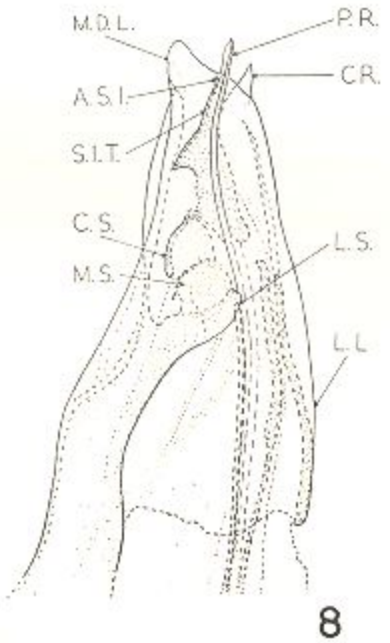
Phalacropsylla hamata Tipton and Mendez, new species Fig. 7–10.

Diagnosis: *Phalacropsylla hamata*, n. sp., is most closely related to *P. paradisea* Rothschild, 1915 but is readily separated from that species on the basis of the following combination of characters: A deep sinus in the caudal margin of the immovable process of the clasper (P) dorsad of its articulation with the movable finger of the clasper (F); 4 long marginal bristles on the apical and subapical portion of P; 2 hook-like spiniforms near the apex of the distal arm of the 9th sternum; and the bifid portion of the proximal arm of the 9th sternum is angulate. *P. paradisea* also has a sinus in the caudal margin of P but it isn't so deep; there are only 2 long bristles on the apical portion of P; there are 3 hook-like spiniforms near the apex of the distal arm of the 9th sternum; and the fingers of the bifid portion of the proximal arm of the 9th sternum are slender and curved.

♂. *Head*: (Fig. 7). Anterior margin evenly rounded, without frontal tubercle; pre- and postantennal region with micropores fairly evenly distributed, each region with 3 dermal pits; preantennal area with anterior row of medium-sized bristles, posterior row of 4 long bristles with short intercalary setae. Genal ctenidium consisting of 2 crossed teeth, inner tooth almost 2× as

long as outer tooth. Eye vestigal. Elongate maxillary lobe with acuminate apex reaching last segment of maxillary palpus. Segments 1 and 2 of maxillary palpus of about equal length, segment 3 slightly shorter, last segment longer than preceding segments; all segments with numer-





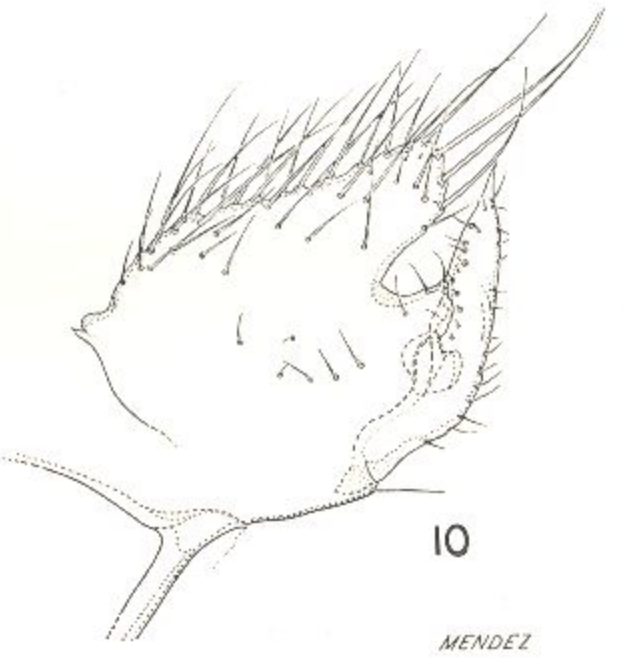


Fig. 7–10. *Phalacropsylla hamata*, n. sp.: 7, Holotype ♂: head, prothorax and procoxa; 8, apex of aedeagus; 9, 8th and 9th sterna; 10, process and immovable finger of clasper.

ous short bristles but fewer on postero-marginal areas. Five-segmented labial palpus reaches apex of forecoxa; segment 1 long, next 3 segments shorter, apical segment as long as segment 1. Antennal scape with transverse row of about 6 bristles; pedicel with complete marginal row of short bristles; antennal club with 9 segments, each fringed with minute bristles in addition to several small lateral bristles; antero-marginal area and apex of club with short, stout bristles. Postantennal area with 1 conspicuous, medium-sized bristle inserted near base of antenna; 1st antennal row with bristles of varying sizes, marginal bristles smallest, proximal bristle facing antennal fossa, largest; posterior row of 4 long bristles with shorter intercalary bristles; ventrad bristle of row exceeds others in length, extending beyond pronotal flange; dorsal margin of antennal fossa with series of short bristles.

Thorax: Pronotum with 1 row of about 12 bristles on each side. Pronotal ctenidium composed of about 14 spines. Sternopleuron with caudal margin rounded. Mesonotum with 4 rows of bristles, those of cephalad row short; 2nd row of 3 or 4 short, irregular bristles; remaining 2 rows with more bristles, evenly spaced; long bristles of last row extended beyond caudal margin; 3 pseudosetae on each side of metanotal flange. Metanotum with 3 rows of bristles, cephalad row reduced; 2nd row of 6 or 7 bristles; last row arranged along dorsal metanotal ridge, consisting of 4 or 5 relatively long bristles alternating with short intercalaries. Mesepisternum apparently with 1 bristle inserted near caudo-ventral angle. Mesepimeron with 5 bristles arranged in 2 definite rows. Metepisternum apparently with 1 long bristle between 2 short ones in dorso-caudal angle. Metepimeron with 6 bristles in vertical arrangement 2–3–1. *Legs*: Procoxa with numerous bristles distributed over inner surface and on marginal area. Mesocoxa with bristles along anterior margin; apical bristles longest; sinus with typical group of 3 subequal bristles above 2 short mesal bristles; 2 very short bristles inserted on dorso-lateral area. Metacoxa with distinct patch of short, submarginal setae on antero-apical area; sinus with 3 lateral bristles, the caudalmost shorter and more robust; dorso-marginal area with 3 short bristles. Protrochanter with 1 antero-marginal bristle, 2 shorter mesal bristles on ventral surface, plus 1 or 2 patches of minute setae. Mesotrochanter with 1 antero-marginal bristle, distinct row of short mesal setae, group of dorso-lateral bristles plus 1 short bristle on inner, lower area. Metatrochanter with 2 antero-lateral bristles; conspicuous mesal row of minute setae plus group of dorso-lateral short setae. Profemur with row of dorso-marginal bristles ending with 2 distinct strong, apical bristles; antero-lateral row limited to 4 bristles, 2 on upper half and 2 on lower half; inner surface with few scattered setae. Setation of mesofemur and metafemur similar to that of profemur but denser. Dorso-caudal margin of each tibia with comb of stout bristles arranged essentially in pairs. Tarsal segments 1–4 of all legs with long, slender bristles; 5th tarsal segment with 4 pairs lateral plantar bristles.

Abdomen: Terga I and II each with 3 rows of bristles; first 2 rows with short bristles; 3rd row larger, with numerous long bristles alternating with intercalaries. Terga III–VII with 2 rows of bristles each. Flanges of terga I–IV with essentially 3 marginal spinelets per side. Antesensilial bristles stout, 3 in number, central 1 longer than other 2, uppermost shorter than lowermost. *Modified abdominal segments*: Sternum VIII well developed, covers most of 9th sternum, almost as long as broad, with caudal margin shallowly sinuate; ventral margin almost straight, bearing 2 submarginal bristles 1/2 as long as 3rd marginal bristle. Proximal arm of 9th sternum almost as long as distal arm; apex bifurcate; anterior branch smaller, directed cephalad; posterior branch larger, caudally oriented. Apex of distal arm of 9th sternum dilated, subtruncate with dorsal margin convex, apparently with 2 subapical bristles; ventro-caudal margin with about 7 spiniforms varying in size and shape, proximal spiniforms below ventro-caudal angle hook-shaped, longer than others; ventral margin slightly sinuate; inner surface with bristles distributed as illustrated. Immovable process of clasper (P) (fig. 10) massive, almost as long as broad; with dorsal margin densely covered with moderately long bristles; apical margin irregularly sinuate, indented, with deep sinus between apex of clasper and junction of P and F. Acetabular bristles relatively short, inserted on caudal margin of immovable process. Manubrium

well developed, almost as long as immovable process, apex reaches end of aedeagal apodeme. Movable finger of clasper (F) (fig. 10) elongate, narrow, apex acute, not extending beyond P; with several short marginal and submarginal bristles as illustrated. *Aedeagus*: Aedeagal apodeme almost 2× length of aedeagus proper. Aedeagus (fig. 8) simple, not longer than broad, but without apical spur; with anterolateral margin slightly convex, with fold anterad of median dorsal lobe; median dorsal lobe (M.D.L.) subangular, with apex evenly rounded. Crochet (CR) reduced, apex acuminate. Lateral lobe (L.L.) not prominent, elongate. Sclerotized inner tube (S.I.T.) slightly expanded, with slender apex (S.S.I.). Crescent sclerite (C.S.) prominent. Lateral sclerite (L.S.) curved dorsad, with rounded apex. Median sclerite (M.S.) with thick, curved anterior margin.

Type Material: Holotype ♂ (Field no. CP 34) ex rodent nest; Cerro Potosi, Nuevo Leon, Mexico; 3050 m, 20.IV.1964, collected by V. J. Tipton et al. Deposited in the U.S. National Museum.

Strepsylla species[4]

Cerro Potosi Material: 71 specimens as follows:

Host	No. of Positive Hosts	April/May ♂	April/May ♀	September ♂	September ♀
Peromyscus melanotis	31	9	16	7	10
Peromyscus d. difficilis	7	4	4	0	0
Peromyscus species	5	0	5	0	0
Microtus mexicanus subsimus	1	1	0	0	0
Nests	3	1	14	0	0
Total		15	39	7	10

Remarks: With the exception of 1 specimen all of our material was collected from the 2 species of *Peromyscus* present in the area or from their nests. Probably more specimens were associated with *P. melanotis* than the chart indicates because the hosts labeled merely *Peromyscus* sp. were likely *P. melanotis*. All of our *Strepsylla* specimens were collected at elevations of 2290–3600 m but mostly (87.9%) 3050–3600 m. The seasonal distribution shown above is slightly misleading because no nests were collected in the fall. However, only 376 specimens of *P. melanotis* were collected in the spring compared with 590 specimens collected in the fall (flea indices of .064 and .029 on *P. melanotis*) which indicates that this flea may be somewhat more abundant in the spring.

Rhadinopsylla fraterna (Baker)

Typhlopsylla fraterna Baker, 1895, Can. Ent. **27**: 189–90. Type host not recorded; Brookings, South Dakota.

Cerro Potosi Material: 2♀♀ ex rodent nest, IV.1964, 2900 m elevation; 1♀ ex *P. melanotis*, IV.1964, 3760 m.

Remarks: The assignment of these specimens to this species is tentative and confirmation must await the collection of males in the Cerro Potosi area.

Rhadinopsylla mexicana (Barrera)

Rectofrontia mexicana Barrera, 1952, Ciencia **11**(10–12): 293–94. Holotype ♀ ex *Peromyscus*

4. To be described by Traub and Barrera

melanotis Allen and Chapman; Foldas del volcan Popocatepetl, Mexico; 3100 m elevation; 28.X.1950.

Cerro Potosi Material: 15♀♀ and 10♂♂ as follows: 8♀♀, 3♂♂ ex *P. melanotis*, IV & V. 1964, 3080–3450 m elevation; 1♀ (IX), 2♂♂ (IV) ex *P. difficilis*; 1♀, 2♂♂ ex *Peromyscus* sp., IV.1964, 3200–3350 m; 1♀ ex *M. mexicanus subsimus*, V.1964, 3290 m; 1♂ 1♂ ex *N. albigula leucodon*, IX.1964, 3140 m; 3♀♀, 2♂♂ ex rodent nest, IV.1964, 2900 m; 1♀, ibid., except 3660 m.

Remarks: Females fit original description and Barrera confirmed identification of both ♀♀ and ♂♂. The ♂ will be described by Barrera.

Ctenophthalmus pseudagyrtes Baker

Ctenophthalmus pseudagyrtes Baker, 1904, Proc. U. S. Nat. Mus. **27**: 420–21, 423, 451. Type specimens (♂, ♀) ex *Geomys bursarius*; Agricultural College, Michigan.

Cerro Potosi Material: 177 specimens as follows:

Host	April/May			September		
	No. of Positive Hosts	♂	♀	No. of Positive Hosts	♂	♀
Microtus mexicanus subsimus	16	19	29	(30)	39	24
Peromyscus melanotis	8	9	6	(8)	6	4
Peromyscus d. difficilis	1	2	2	(1)	1	0
Peromyscus species	1	0	1	(0)	0	0
Nests	6	7	28	(0)	0	0
Total		37	66		46	28

Occurrence of *Ctenophthalmus pseudagyrtes* Baker on *Microtus mexicanus subsimus* according to elevation, season and sex of host:

	No. of Positive Hosts	Elevation in thousands of feet (meters in parenthese): 8–9 (2.4–2.7)	9–10 (2.7–3.1)	10–11 (3.1–3.4)	11–12 (3.4–3.7)	12–12.5 (3.7–3.8)
Spring						
Male hosts	28	1	1	19	2	5
Positive hosts	7	0	0	5	1	1
Percent of Hosts Positive	25	0	0	26.3	50.0	20.0
Number of *C. Pseudagyrtes*		0	0	14	1	1
Flea Index	2.3	0	0	2.8	1	1
Female hosts	23	0	0	18	1	4
Positive hosts	9	0	0	8	0	1
Percent of hosts positive	39.1	0	0	44.4	0	25.0
Number of *C. Pseudagyrtes*		0	0	31	0	1
Flea index	3.5	0	0	3.87	0	1
Fall						
Male hosts	49	0	2	38	2	7
Positive hosts	22	0	2	18	1	1
Percent of hosts positive	44.9	0	100.0	47.3	50.0	14.3
Number of *C. Pseudagyrtes*		0	7	42	1	1
Flea index	2.3	0	3.5	2.33	1	1

	No. of Positive Hosts	8-9 (2.4-2.7)	9-10 (2.7-3.1)	10-11 (3.1-3.4)	11-12 ((3.4-3.7)	12-12.5 (3.7-3.8)
Female hosts	44	0	1	36	1	6
Positive hosts	8	0	1	7	0	0
Percent of hosts positive	18.2	0	100.0	19.1	0	0
Number of *C. Pseudagyrtes*		0	1	11	0	0
Flea Index	1.5	0	1	1.57	0	0

Remarks: In the spring there was a higher percentage of positive ♀ hosts than ♂ hosts (*Microtus*), but in the fall there was a higher percentage of ♂ hosts positive than ♀ hosts. The flea index followed a similar pattern. All of our specimens of *C. pseudagyrtes* were collected from 2990–3770 m elevation, and 95.5% of the specimens were collected at 2990–3350 m. While 77.1% of the total *Microtus* collected came from 3050–3350 m, 82.6% of the positive *Microtus* came from that elevation.

Corrodopsylla curvata (Rothschild)

Doratopsylla curvata Rothschild, 1915, Ectoparasites **1**: 25–27. ♂ and ♀ ex *Blarina brevicauda*; Iowa City, Iowa.

Cerro Potosi Material: 3♀♀ and 1♂ ex (3) *Sorex milleri* Jackson, 1947; 3200 m elevation; 1♂, 30.IV.1964 and 3♀♀, 13.IX.1964.

Remarks: Of 28 shrews captured only 11 study skins were prepared. Of these, 10 were *S. milleri* and 1 was *S. saussurei*. We collected fleas from only 3 shrews, and 2 of these were definitely identified as *S. milleri*. The 3rd specimen was probably *S. milleri*, but there is a possibility that it was *S. saussurei*. It is rather surprising that there were so few specimens of this flea collected. It may be a nest flea or Cerro Potosi may represent the fringe of its range. Our specimens are remarkably like illustrations given by Traub (1950).

Peromyscopsylla hesperomys adelpha (Rothschild)

Leptopsylla adelpha Rothschild, 1915, Nov. Zool. **22**: 304. Holotype ♀ ex *Mus* sp.; Paradise, Arizona; 21.XI.1913; 1♂, ibid., except II.1914.

Cerro Potosi Material: 4♀♀ and 3♂♂ ex (5) *Peromyscus melanotis*: 1♀ from 3140 m elevation: the remainder from 3410–3730 m; IV.1964.

Remarks: This species has been collected from Michoacan, Mexico ex *Peromyscus* sp., and Tipton has collected several specimens in the Big Bend National Park, Texas. It has been collected from many localities in Western USA and Canada and so it is not unusual to find it at Cerro Potosi. The characters which separate the subspecies are variable, but our specimens appear to be nearest *P. hesperomys adelpha*.

Ceratophyllus coahuilensis Eads Fig. 11–14.

Ceratophyllus coahuilensis Eads, 1956, J. Parasitol. **42** (1): 74, pl. Holotype ♂, allotype ♀ and many paratypes of both sexes ex nests of *Petrochelidon fulva pallida*; Uvalde County, Texas; 30.III.1955.

Cerro Potosi Material: 58♀♀ and 50♂♂ ex (5) nests; 3200–3320 m elevation; 1–2.V. 1964.

Remarks: Dr Franz Smit compared our specimens with material in the British Museum. He commented that this is a highly variable species and for this reason we have provided illustrations of the ♂ genitalia (fig. 11–14).

Diamanus montanus (Baker)

Pulex montanus Baker, 1895, Can. Ent. **27**: 131. Type material ex mountain grey squirrel (*Sciurus alberti?*); Fort Collins, Colorado.

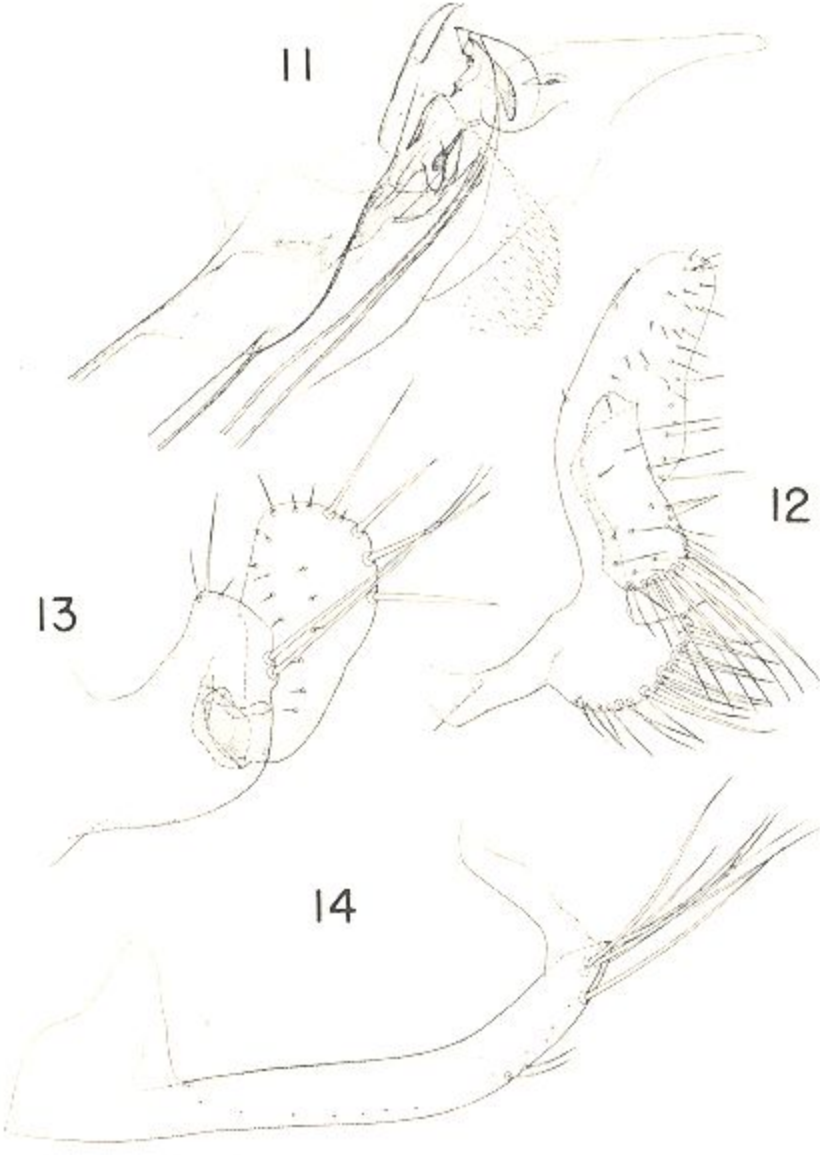


Fig. 11–14. *Ceratophyllus coahuilensis* Eads, 1956: 11, apex of aedeagus; 12, 9th sternum; 13, process and immovable finger of clasper; 14, 8th sternum.

Cerro Potosi Material: 28 specimens as follows: 18♀♀ and 8♂♂ ex (2) *Citellus variegatus couchii*, 1830 m elevation; 2♀♀ ex (2) *Citellus spilosoma pallescens*, 1830 m and 1920 m, IX.1964.

Remarks: There is some variation in *D. montanus*, especially in details of the aedeagus. The immovable process of the clasper (P) is more broadly rounded than in Arizona and Utah specimens and F is thicker. In the ♀♀ the outline of the 7th sternum and the spermatheca is essentially the same in Arizona, Utah and Cerro Potosi specimens.

Dasypsyllus stejnegeri (Jordan)

Ceratophyllus stejnegeri Jordan, 1929, Nov. Zool. **35**: 36–37. Lectotype ♂ (Smit 1961) ex unrecorded host; Bering I., Northern Pacific Ocean; 1882–1883.

Cerro Potosi Material: 6♀♀ and 1♂ ex man, about 3200 m elevation, 22.IV.1964; 2♀♀ ex "bird nest" found in stump of tree, about 3290 m, 1.V.1964; 2♀♀ ex bird nest (containing 4 newly hatched birds) and 2♀♀ and 1♂ ex bird nest (containing 5 eggs). Latter 2 nests in tree about 5 m above ground, about 3220 m elevation, 2.V.1964.

Remarks: The geographical distribution of *D. stejnegeri* is very interesting in that it has been collected from such widely separated localities as islands adjacent to Alaska in the North Pacific and East Falkland in the South Atlantic. Smit (1961) has brought together all existing records which include: 4♂♂ and 4♀♀ from the Alaska area and 3♂♂ and 1♀ from East Falkland. Known hosts are passerine birds with one exception: 1♀ specimen was collected from a hoary marmot, *Marmota caligata*. This is not surprising since these fleas are very active in seeking a host. While the senior author, Tipton, and an associate, David Young, rested by a small stream on Cerro Potosi, they noted several fleas hop onto their legs. The fleas were unusually active, and only 6 (all ♀♀) were collected. Later, an additional specimen ♂ was removed from Tipton.

Malareus euphorbi (Rothschild)

Ceratophyllus euphorbi Rothschild, 1905, Nov. Zool. **12**: 165–66. ♂ ex *Peromyscus canadensis* (=*P. maniculatus borealis*); Horse Creek, British Columbia. ♀ (later described by Holland 1949) ex various subspecies of *Peromyscus maniculatus* and ex *Mustela frenata*; British Columbia, Alberta and Saskatchewan Provinces, Canada; 1940–1945. *Malareus euphorbi* (Rothschild) Jordan, 1933, Nov. Zool. **39**: 76. *Malareus jordani* Fox, 1939, Iowa State J. Sci. **13** (4): 337–38. (**New synonymy**)

Cerro Potosi Material: 7♀♀ and 5♂♂ ex (8) *Peromyscus melanotis*; 20–21.IX.1964; all above 3660 m elevation.

Remarks: This species occurs in western USA and Canada usually at high elevations. Our specimens are not unusual and differ from illustrations given by Holland (1949) only in minor details. In our ♂♂ the apex of the 8th sternum is less expanded and the marginal bristles, especially the lateral bristle on F, are heavier. In our ♀♀ the dorsal lobe of the caudal margin of the 7th sternum is more accuminate, and the end of the spermatheca opposite the tail is somewhat more expanded and more heavily striated. The tail of the spermatheca is shorter.

Opisodasys robustus (Jordan)

Ceratophyllus robustus Jordan, 1925, Nov. Zool. **32**: 105. ♀ type ex unidentified host;

White River, Arizona; VI.1920; 2♀♀ ex *Sciurus aberti*; Riti de los Frijoles, Sandoval County, New Mexico; IX.1910.

Opisodasys robustus (Jordan, 1925) Jellison, 1939, J. Parasit. **35** (5): 414. Description of lectotype ♂ ex *Sciurus niger*; Santa Rita Mountains, Santa Cruz County, Arizona; V.1933.

Cerro Potosi Material: 1♂ ex *Sciurus alleni*; 3210 m elevation; 21.IX.1964.

Remarks: The 1 male in our collection may represent an undescribed subspecies, but in most details it fits the description and illustrations given by Jellison (1939). Both the immovable (P) and movable (F) processes of the clasper are as figured except that the 3 marginal bristles on F are heavier and the margin of P dorsad of the acetabular bristles is not so strongly curved. The 8th sternum has only 1 subapical bristle and lacks the row of lateral setae. The intersegmental membrane is as figured, long and filamentous. Jellison describes the distal arm of the 9th sternum as follows: "Proximal lobe of sternite IX with 2 pale spiniforms. Distal lobe 3 times longer than broad, acute ventrally, squarely truncate dorsally, heavily armed with numerous pale spiniforms along posterior border." In our specimens the distal arm of the 9th sternum is divided into a proximal lobe armed with 5 or 6 long marginal and submarginal bristles and a distal lobe which is clavate and with a truncate apex; the apical 1/2 is armed with pale marginal and submarginal spiniforms, the proximal 1/2 with many lateral pale spiniforms; there is a button-like protuberance at the junction of the proximal and distal lobes.

Orchopeas fulleri Traub

Orchopeas fulleri Traub, 1950, Fieldiana, Zool. Mem. **1**: 60–63; pl. 36. Type material ex "tree squirrel", near Villa Santiago, Nuevo Leon, Mexico; collected by Harry Hoogstraal and Kenneth L. Knight; VI.1940.

Cerro Potosi Material: 11 specimens as follows: 6♀♀ and 3♂♂ ex *Sciurus alleni*; 1♀ and 1♂ ex squirrel's nest; 3110 m elevation; IV & V.1964.

Remarks: Our specimens conform closely to illustrations and descriptions given by Traub (1950) as might be expected since Cerro Potosi and Villa Santiago are both in the State of Nuevo Leon and separated by only 80 km.

Orchopeas neotomae Augustson

Orchopeas sexdentatus neotomae Augustson, 1943, Bull. S. Calif. Acad. Sci. **42**: 49–51. Type specimen ex *Neotoma lepida devia*; South Entrance, Grand Canyon National Park, Coconino County, Arizona.

Cerro Potosi Material: 13♀♀ and 4♂♂ ex (6) *Neotoma albigula leucodon*: 1♀ from 2740 m elevation, 1♀ from 3440m, the remainder from 3050–3140 m; 7♀♀ and 2♂♂ collected IV & V.1964; 6♀♀ and 2♂♂ collected IX.1964.

Remarks: Cerro Potosi material varies little from the illustrations and description given by Augustson (1943). In our male specimens the caudal margin of F is not straight but slightly sinuate, and there is some variation in the dorsal lobe of the apical arm of the 9th sternum, especially the caudal angle which is longer and more acuminate in our specimens. In the female the outline of the 7th sternum differs from the illustrations in that the dorsal lobe is not so angulate but rounded, and the tail of the spermatheca has a pronounced apical sclerotized papilla.

Opisocrostis hirsutus (Baker)

Pulex hirsutus Baker, 1895, Can. Ent. **27**: 130, 132. ♀ ex prairie dogs; Stove Prairie, Larimer County, Colorado.

Opisocrostis hirsutus (Baker) Jordan, 1933, Nov. Zool. **39**: 73.–Jellison, 1939, Pub. Health Repts. **54**: 580. ♂ ex prairie dogs; Jefferson Canyon, Broadwater County, Montana.

Cerro Potosi Material: 100 specimens as follows:

Occurrence of *Opisocrostis hirsutus* on *Cynomys mexicanus* according to season and sex of host:

	April/May		September		
	♂	♀	Sex Unknown	♂	♀
Total Hosts (*Cynomys mexicanus*)	5	5	3	2	2
Positive Hosts	4	3	1	2	0
Number of Specimens of *O. hirsutus*	63	4	30	3	0
Flea Index	15.75	1.3	30	1.5	0

Remarks: Our sample was too small to be definitive. It appears that both *Pulex simulans* and *O. hirsutus* live on the same host specimens concurrently but the numerical ratio changes from season to season (see "Remarks" under *P. simulans*).

Jellisonia hayesi Traub

Jellisonia hayesi Traub, 1950, Fieldiana: Zool. Mem. **1**: 17–19; pl. 3, 4 and fig. 1, 2 and 3 of plate 5. Holotype ♂, allotype ♀ and paratype ♂ ex *Peromyscus hylocetes* Merriam, Mexico; Mt San Miguel, Michoacan, 1980 m elevation, 31.VII.1941, collected by Robert Traub. *Jellisonia hayesi breviloba* Traub, ex *Microtus mexicanus* Saussure, Mexico; Mexico City, 10.V.1933, collected by Dr Alfonso Dampf.

Cerro Potosi Material: 23 specimens ex (15) *Peromyscus difficilis difficilis* as follows: 8♀♀ and 5♂♂, IV & V, 5♀♀ and 5♂♂, IX.1964; 2060–3050 m elevation, but 78.26% from 2130–2440 m.

Remarks: Our specimens are close to *Jellisonia hayesi breviloba* Traub, 1950 but in some details of both male and female genitalia they appear to be intermediate between the nominate subspecies and *breviloba*. The process and finger of the clasper are as in *hayesi* but the protuberance on the caudal margin of P bearing the acetabular bristles is shorter. The 8th sternum is as in *breviloba* and the process of the intersegmental membrane between the 8th and 9th sterna is enlarged, conspicuous and spiculose, and the apical portion is long and sinuate as figured by Traub (1950) for *breviloba*. The distal arm of the 9th sternum lacks the prominent caudal lobe characteristic of *hayesi* and the general shape and setation is like that of *breviloba*. The crochet is flask-shaped as in *hayesi*, but the apex has a more pronounced beak. In the female the caudal margin of the 7th sternum is highly variable and intermediate between *hayesi* and *breviloba*, but most specimens lack the prominent dorsal lobe. The spermatheca is expanded at the end opposite the tail and heavily striated; the tail is bent not so abruptly as *breviloba* but more so than *hayesi*.

Pleochaetis asetus Traub, new status Fig. 16, 20, 24, 28, 28a, 32.

Pleochaetis equatoris asetus Traub, 1950, Fieldiana: Zool. Mem. **1**: 33–34, pl. 17. Holotype

♂ ex *Callospermophilus lateralis arizonensis* or *Microtus mexicanus mogollonensis*, New Mexico, Mogollon Mts, collected by H. S. Gentry, 1.IX.1933.

Cerro Potosi Material: 219 specimens as follows:

HOST	April/May No. of Positive Hosts	♂	♀	September No. of Positive Hosts	♂	♀
M. mexicanus subsimus	30	50	51	35	49	53
P. melanotis	5	4	1	1	1	0
P. difficilis difficilis	2	5	0		0	0
M. frenata	1	0	3		0	0
Rodent nests	2	1	1		0	0
Total	40	60	56	36	50	53

Remarks: In our male specimens the apex of the distal arm of the 9th sternum is broadly rounded, and the bristles are coarser than shown by Traub (1950). The caudal margin of the immovable process of the clasper (P) is more deeply indented and both lateral and marginal bristles of the movable process of the clasper (F) are heavier in our specimens. The crochet is subtruncate, not truncate as shown by Traub, and the median dorsal lobe (M.D.L.) is more strongly curved. Most of our female specimens have a deep but narrow sinus in the caudal margin of the 7th sternum. The spermatheca is somewhat like that figured by Barrera (1954) and labeled *Pleochaetis apollinaris aztecus*.

We consider *Pleochaetis asetus* Traub to be a valid species and our specimens represent a subspecies distinct from the nominate subspecies. This can only be determined after additional material from the Mogollon Mts in New Mexico has been studied as a part of a generic revision.

Of the 219 specimens collected, 92.6% were associated with *Microtus mexicanus subsimus* and represented 60.49% of the total fleas on this host. The number of males and females were essentially equal, but female fleas were more abundant on male hosts. The majority of specimens (97.71%) were collected above 3000 m elevation, and 81.75% were collected between 3100 and 3400 m.

Pleochaetis aztecus Barrera, new status Fig. 15, 19, 23, 27, 27a, 31.

Pleochaetis apollinaris aztecus Barrera, 1954, Ciencia **14**: (7–8), 138–39; 3 fig. Holotype ♂ ex *Peromyscus maniculatus labecula*; Mexico, Faldas del Volcan Popocatepetl, 3100 m elevation, collected by A. Barrera and G. W. Wharton, 28.X.1950. Allotype ♀ ex *P. maniculatus labecula*; Mexico, la Venta, D. F. 2800 m elevation, collected by A. Barrera, 21.XI.1951.

Cerro Potosi Material: 2709 specimens as follows:

Host	April/May No. of Positive Hosts	♂	♀	September No. of Positive Hosts	♂	♀
P. melanotis	278	573	936	327	405	594
P. difficilis	25	24	46	5	4	3
Peromyscus species	17	28	45		0	0
M. mexicanus	6	4	5	6	5	

N. albigula	2	0	3	1	0	1
S. milleri	1	0	1	1	0	1
M. musculus	1	1	0		0	0
Rodent nests		13	16		0	0
Total	330	643	1,052	340	414	600

Remarks: In our female specimens the spermatheca looks very much like that illustrated by Traub (1950) for *Pleochaetis parus* Traub. There is an unusual amount of variation in the posterior margin of the 7th sternum, but most of our specimens have a deep sinus with a subacuminate dorsal lobe and a rounded ventral lobe, quite unlike illustrations given by Barrera (1954). In the male, the dorsocaudal margin of P is truncate and the caudal margin of F, ventrad of the strong bristle, is not sharply recessed as shown by Barrera.

Undoubtedly, our specimens represent a subspecies, or perhaps a species, distinct from that described by Barrera. However, to describe new taxa would only add to the general confusion which is characteristic of the genus *Pleochaetis* at the present time.

Pleochaetis sibynus (Jordan) Fig. 17, 18, 21, 22, 25, 26, 29, 29a, 30, 30a, 33–36.

Ceratophyllus sibynus Jordan, 1925, Nov. Zool. (32): 110, fig. 42.

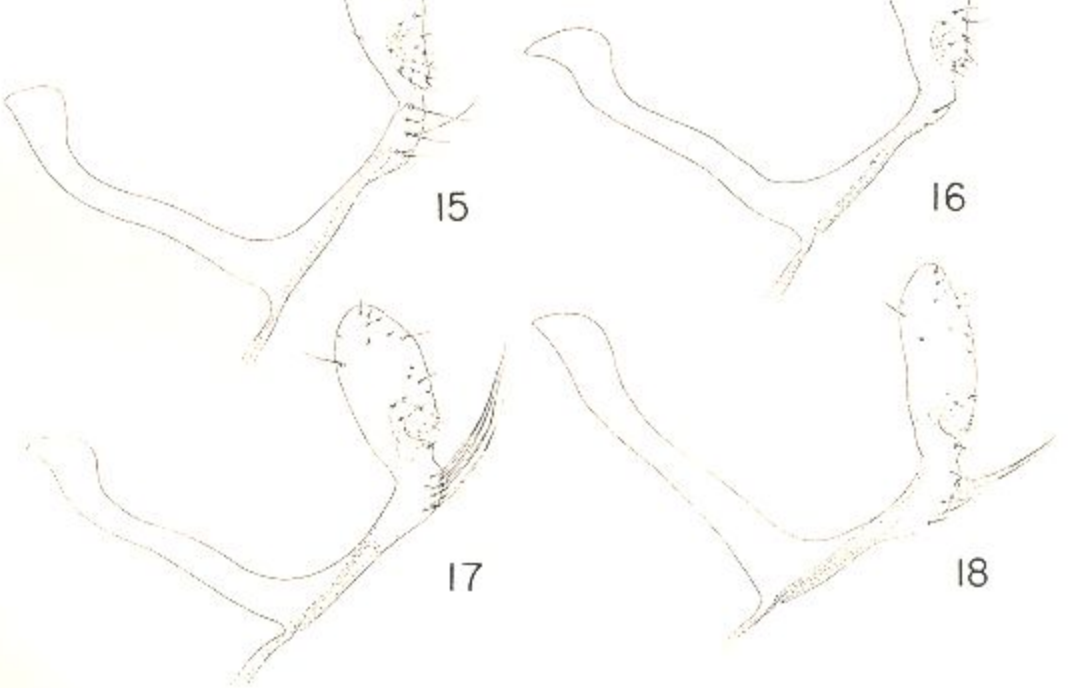
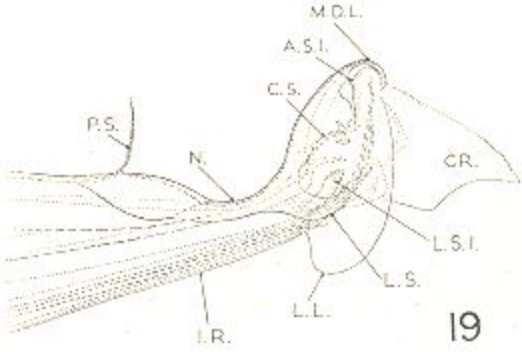


Fig. 15–18. Ninth sternum of male: 15, *Pleochaetis aztecus*; 16, *Pleochaetis asetus*; 17, *Pleochaetis sibynus* ex *Peromyscus melanotis*; 18, *Pleochaetis sibynus* ex *Peromyscus difficilis difficilis*.



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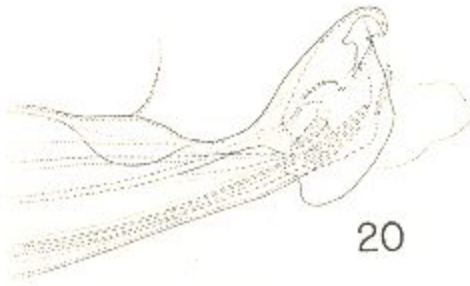

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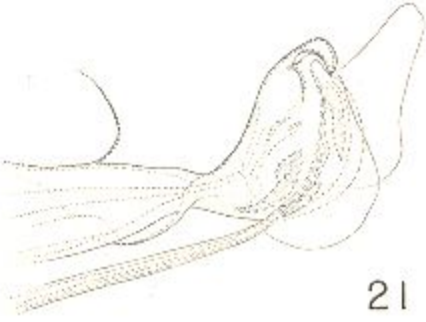

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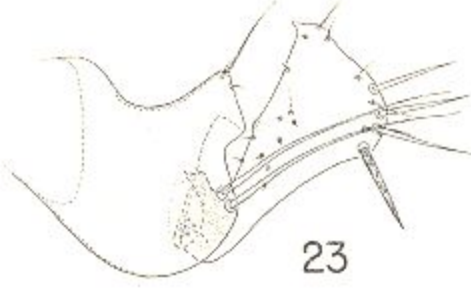

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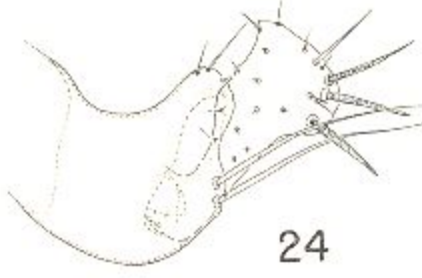

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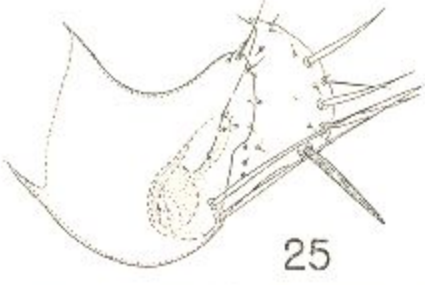

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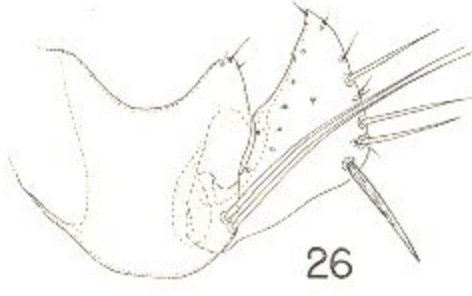

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Fig. 19–22. Apex of aedeagus: 19, *Pleochaetis aztecus*; 20, *Pleochaetis asetus*; 21, *Pleochaetis sibynus* ex *Peromyscus melanotis*; 22, *Pleochaetis sibynus* ex *Peromyscus difficilis difficilis*. Fig. 23–26. Process and immovable finger of clasper: 23, *Pleochaetis aztecus*; 24, *Pleochaetis asetus*; 25, *Pleochaetis sibynus* ex *Peromyscus melanotis*; 26, *Pleochaetis sibynus* ex *Peromyscus difficilis difficilis*.

Type Data: Holotype ♂ ex "skunk". Arizona: Paradise. ♀ ex *Peromyscus melanotis* Allen and Chapman, Mexico: State of Michoacan. Mt Tancitaro (3050 m elevation), near municipality of Tancitaro, 19.VII.1941, collected by Robert Traub.

Additional Records: ex *Peromyscus maniculatus rufinus* Merriam, Grand Canyon, Arizona; ex *Microtus mexicanus phoeus* Merriam same data as allotype; ex *Peromyscus* and

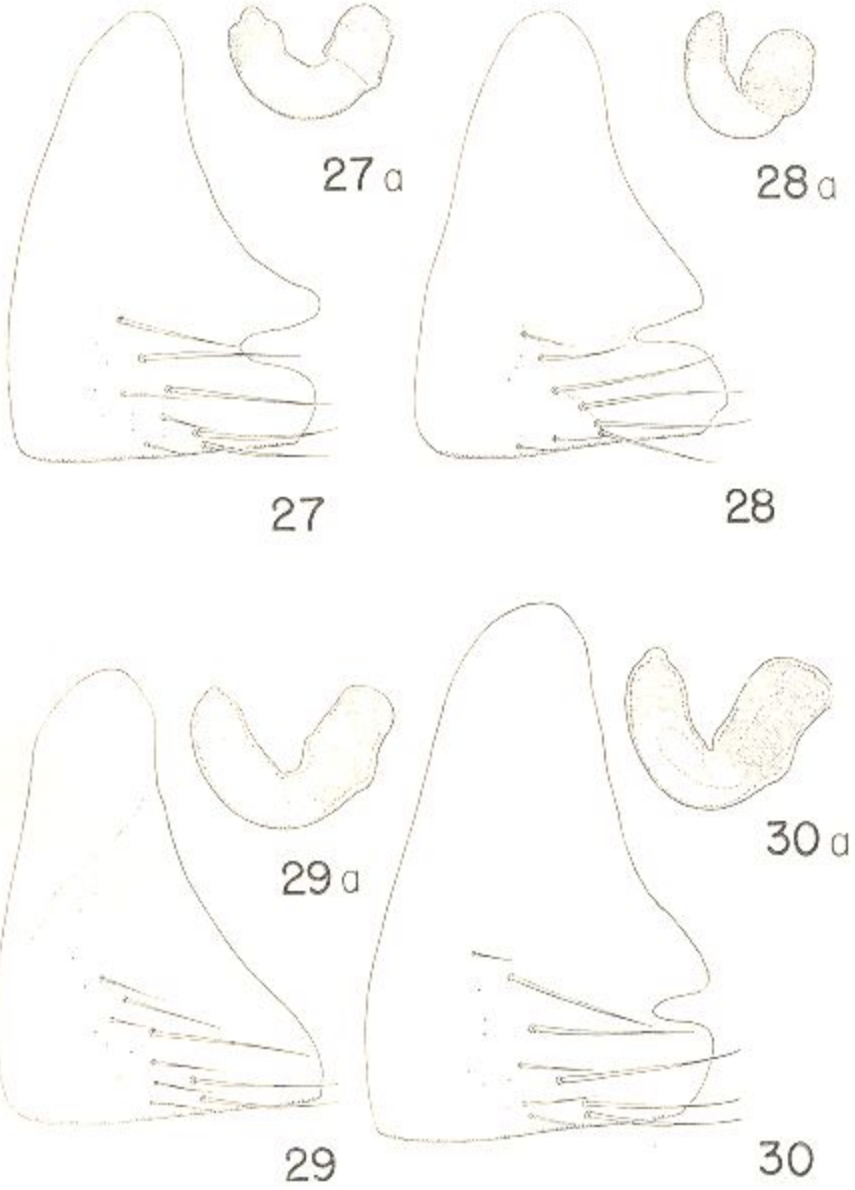


Fig. 27–30. Female 7th sternum and spermatheca: 27–27a, *Pleochaetis azteeus*; 28–28a, *Pleochaetis asetus*; 29–29a, *Pleochaetis sibynus* ex *Peromyscus melanotis*; 30–30a, *Pleochaetis sibynus* ex *Peromyscus difficilis difficilis*.

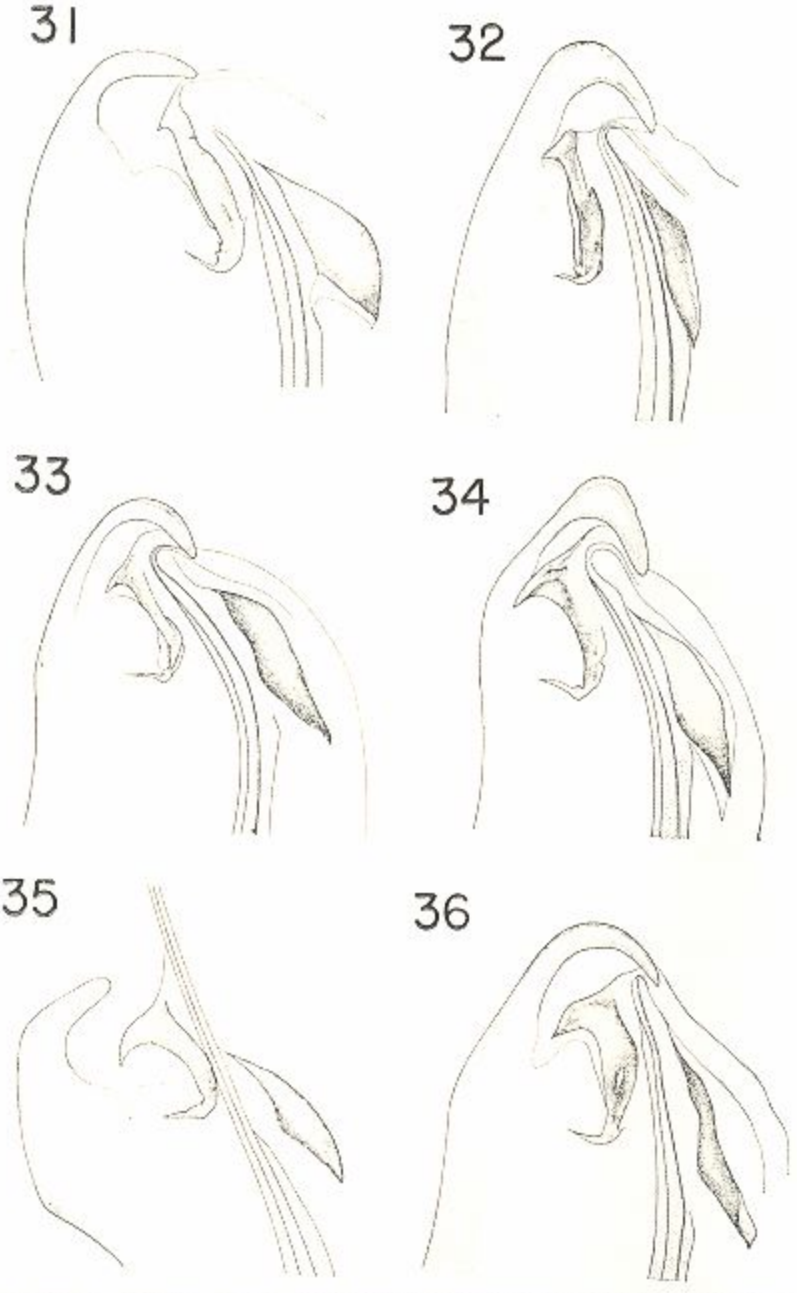


Fig. 31–36. Median dorsal lobe, apex of sclerotized inner tube and lateral sclerotization of inner tube: 31, *Pleochaetis aztecus*; 32, *Pleochaetis asetus*; 33, *Pleochaetis sibynus* ex *Peromyscus melanotis*; 34, *Pleochaetis sibynus* ex *Peromyscus difficilis difficilis*; 35, *Pleochaetis sibynus* ex unknown host (Mt Tancitaro, Mexico: Traub collection); 36, *Pleochaetis mathesoni* ex *Reithrodontomys* sp. (Mt Tancitaro, Mexico; Traub collection).

Microtus, Ojo de Agua, Galena and Cerro Potosi (3810 m elevation) Nuevo Leon, Mexico.

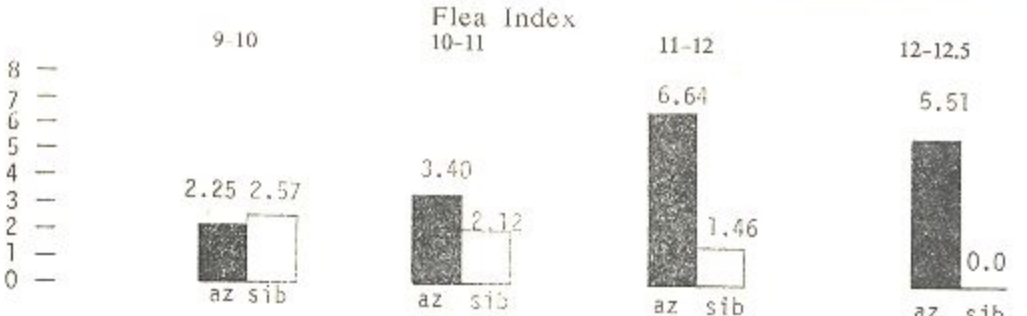
Cerro Potosi Material: 941 specimens as follows:

Host	April/May			September		
	No. of Positive Hosts	♂	♀	No. of Positive Hosts	♂	♀
P. melanotis	153	164	212	134	107	119
P. difficilis	74	62	105	22	28	21
Peromyscus species	16	18	23		0	0
N. albigula	8	7	8	3	3	0
M. mexicanus	2	0	2	2	0	2
R. fulvescens	2	1	1	0	0	0
Rodent nests	7	26	32		0	0
Total	262	278	383	161	138	142

Occurrence of *P. aztecus* and *P. sibynus* on *Peromyscus melanotis* according to season, elevation and sex of host:

Elevation in thousands of feet (meters in parentheses):

	9–10 (2.7–3.1)		10–11 (3.1–3.4)		11–12 (3.4–3.7)		12–12.5 (3.7–3.8)	
Spring	az	sib	az	sib	az	sib	az	sib
Female Hosts	1	1	70	49	16	6	14	0
Fleas	4	5	332	147	138	8	99	0
Index	4.0	5.0	4.74	3.0	8.62	1.33	7.07	0
Male Hosts	3	2	108	89	31	6	34	0
Fleas	5	4	466	201	250	11	215	0
Index	1.66	2.0	4.31	2.25	8.06	1.83	6.32	0
Fall								
Female Hosts	0	0	104	56	7	0	22	0
Fleas	0	1	268	98	21	0	116	0
Index	0	1.0	2.57	1.75	3.0	0	5.27	0
Male Hosts	0	3	143	71	16	3	36	0
Fleas	0	8	382	116	56	3	155	0
Index	0	2.66	2.67	1.63	3.5	1.0	4.30	0



az=Pleochaetis aztecus

sib=Pleochaetis sibynus

We are aware, as our illustrations indicate, that there are 2 populations, possibly subspecies, in the specimens labeled *Pleochaetis sibynus*. Specimens associated with *Peromyscus melanotis* are quite distinct from those associated with *Peromyscus difficilis*. The differences are primarily in the shape of P and F, the spermatheca, and in details of the aedeagus, especially the median dorsal lobe, the apex of the sclerotized inner tube and the crochet.

Traub (1967) has indicated that he and Barrera are studying the genus *Pleochaetis*. He emphasized the extreme confusion which currently characterizes this genus. Since these 2 outstanding students of Siphonaptera are working on a revision of this important genus we choose to give our specimens tentative names and allow Traub & Barrera to study our material as a part of a more difinitive work.

Foxella ignota (Baker) Fig. 37–42.

Pulex ignotus Baker, 1895, Can. Ent. **27**: 110. Type ex unknown host; Ames, Iowa.

Cerro Potosi Material: 65♀♀ and 42♂♂ as follows: 57♀♀, 34♂♂ ex (9) *Thomomys umbrinus analogus*, IV.1964; 2 ♀♀, 1♂ ex (1) *Mustela frenata*, I.V.1964; 1♂ ex *Peromyscus melanotis*, 25.IV.1964; 6♀♀, 6♂♂ ex (2) rodent nests, IV.1964; 11 specimens from 2740–3050 m, 1 above 3660 m, remainder collected from 3050–3350 m elevation.

Remarks: Initially we intended to describe a new subspecies based on our Cerro Potosi material, which resembles both *Foxella ignota ignota* (Baker 1895) and *F. ignota albertensis* (Jordan & Rothschild 1915) in details of the male genitalia. Our decision not to describe it is based on the extreme variation in our specimens, especially in the chaeotaxy of the head and thorax. Our specimens collected from nests (probably woodrats') appeared to have a reduced number of spines (20 compared with 24) in the pronotal comb as well as fewer bristles on the lateral plates of the thorax, than those collected from pocket gophers.

Although the number of fleas collected is insufficient for statistical analysis our limited material does suggest that sex of host may exert some influence on the distribution of *Foxella ignota*.

Flea index according to sex of host:

	♂ Hosts	♀ Hosts
Fleas:		
Males	5.4	3.6
Females	9.0	5.25

Foxella mexicana I. Fox Fig. 43–46.

Foxella mexicana I. Fox, 1939, Iowa State Col. J. Sci. **13** (4): 337. Holotype ♀ and ♂ paratype ex "pocket gopher", Cerro Potosi, Nuevo Leon, Mexico; 13.VII.1938.

Since the original description was based on females only, the description of the male is given below.

Diagnosis: *Foxella mexicana* I. Fox is very close to *F. hoogstraali* Traub, 1950, and, in fact, the latter may be a subspecies of the former. They are similar in several aspects of the male genitalia but especially in the shapes of the immovable and movable processes

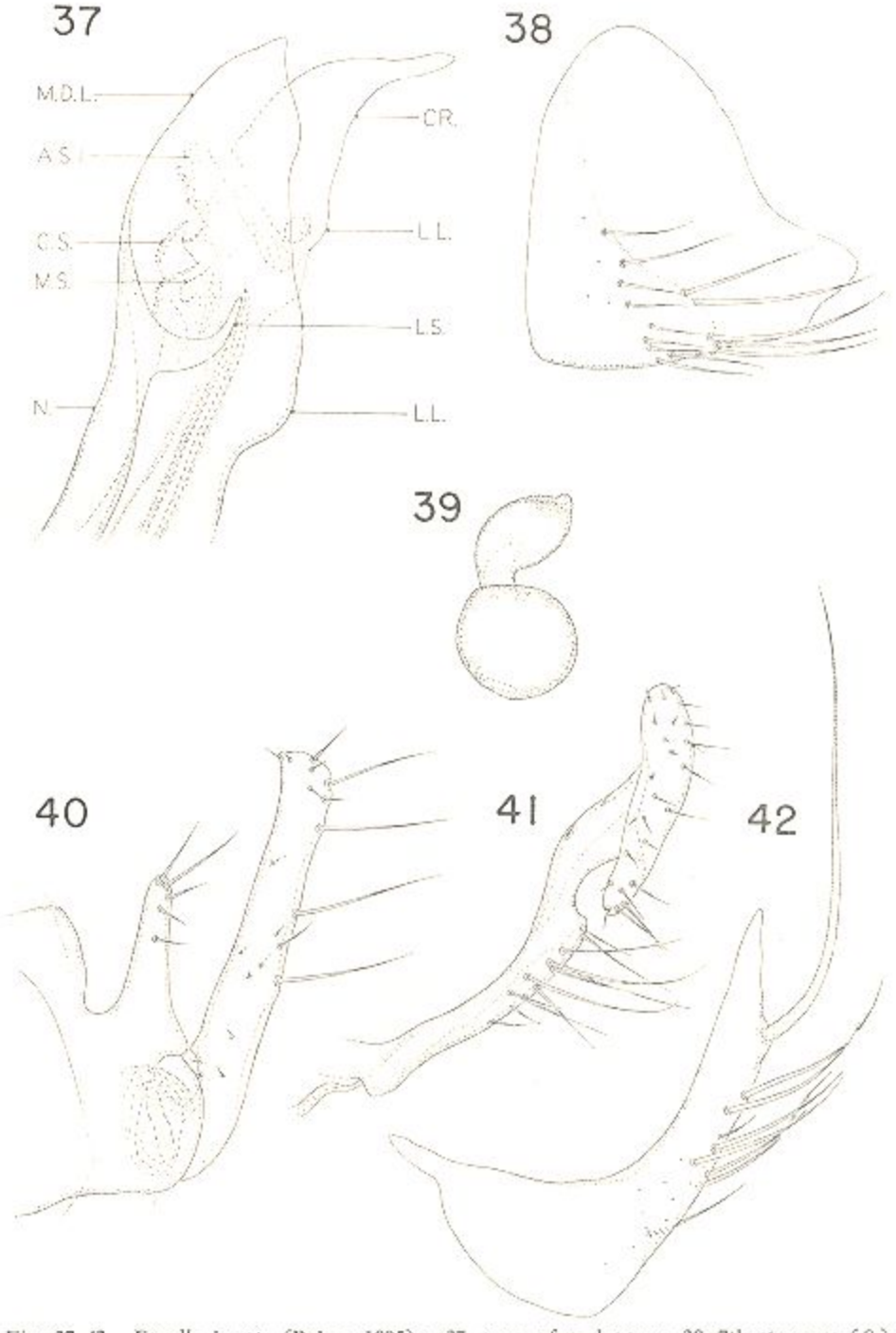


Fig. 37–42. *Foxella ignota* (Baker, 1895): 37, apex of aedeagus; 38, 7th sternum (♀); 39, spermatheca (♀); 40, process and immovable finger of clasper; 41, 9th sternum; 42, 8th sternum.

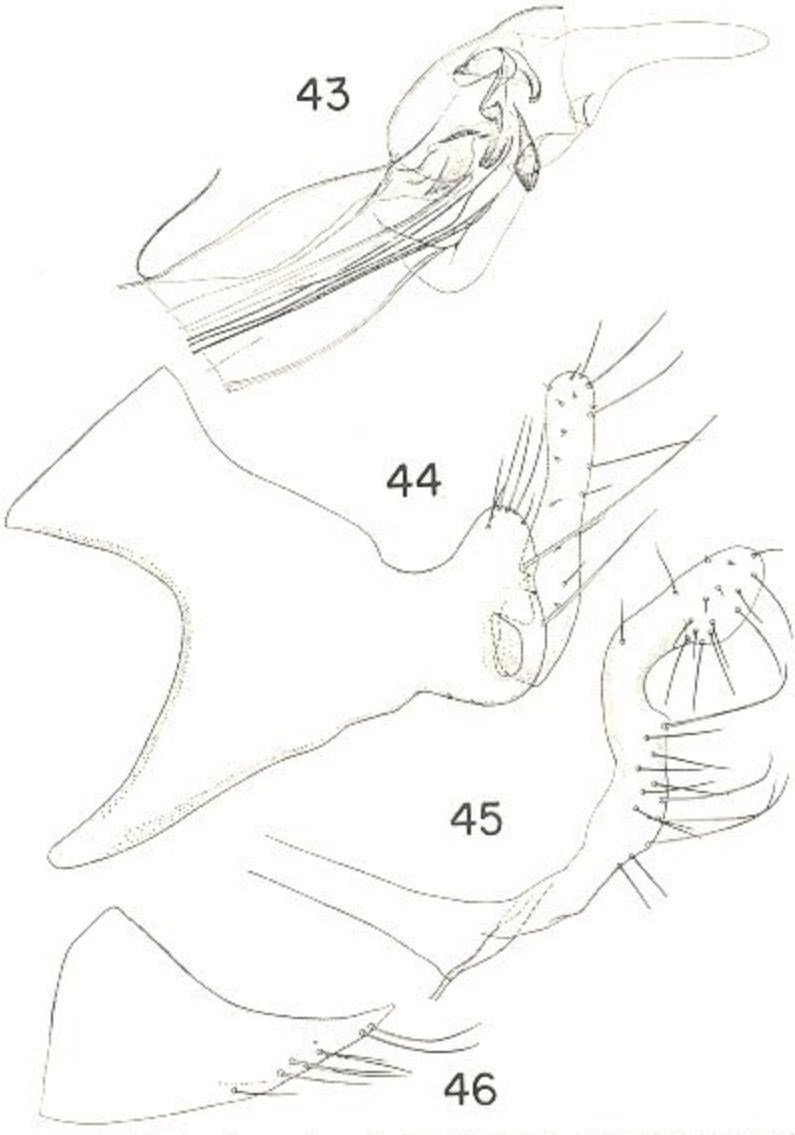


Fig. 43–46. *Foxella mexicana* (I. Fox, 1939): 43, apex of aedeagus; 44, 9th sternum; 45, process and immovable finger of clasper; 46, 8th sternum.

of the clasper and the 8th sternum. However, the apex of the crochet is slender and finger-like as in *F. ignota* rather than triangular in shape as in *F. hoogstraali*. In addition, the proximal lobe of the distal arm of the 9th sternum is not dilated as in *F. hoogstraali* but the apical lobe is somewhat swollen.

♂ *Head*: Anterior margin evenly rounded, with tubercle; frontoclypeal area porose, with 3 prominent submarginal discs; preantennal area with 2 rows of bristles, 7–9 bristles in 1st row, 6–7 bristles in 2nd row usually with 1 displaced. Eye absent. Genal process subacuminate, with 2

subapical bristles. Maxillary lobe does not reach apex of 2nd segment of labial palpus. Scape of antenna with several small lateral bristles. About 14 small bristles on dorsal margin of antennal groove. Postantennal area with 1 large, submarginal bristle plus 3 prominent discs; postero-marginal row of 6 long bristles.

Thorax: Pronotal comb with total of about 20 spines, ventralmost spine much reduced; row of 6–8 long bristles, with smaller intercalary bristles, cephalad of comb. Mesonotum and metanotum each with 2 rows of bristles; mesonotum with several small bristles on anterior 1/3 plus long, delicate pseudosetae near caudal margin; metanotum with apical spinelet. Mesepisternum with 4–6 bristles plus patch of small bristles in dorsal angle. Mesepimeron with 5–6 bristles. Lateral metanotal area with about 5 bristles. Metepisternum with 3 long bristles near dorso-caudal angle. Metepimeron with 10–14 bristles. *Legs*: Meso- and metafemora with lateral row of about 10 bristles. 5th tarsal segment each with 5 pairs of lateral plantar bristles.

Abdomen: Tergum I with 3 rows of bristles; 2 rows of bristles on other terga; terga I–IV each with apical spinelet. Sterna II–VI each with row of about 6 strong bristles plus patch of smaller bristles. Three antepygidial bristles, dorsal bristles much reduced, middle bristle longest. *Modified abdominal segments*: (fig. 43–46) Tergum VIII with dorsal area spiculose; approximately 32 marginal, submarginal or lateral bristles. 8th sternum (fig. 46) broad basally, acuminate apically; with about 7 marginal or submarginal bristles. Immovable process of clasper (fig. 44) 137.5 μ long measured from ventralmost point to apex; broadly rounded apically, with 4–6 small apical or subapical bristles; caudal margin with only slight sinus; with 2 submarginal acetabular bristles widely separated. Movable finger (fig. 44) 225 μ long measured from ventralmost point to apex, 37.5 μ wide measured at level of apex of P; with 3 long bristles on caudal margin plus 2–3 smaller apical or subapical bristles, several small lateral bristles. Distal arm of the 9th sternum (fig. 45) bilobed; dorsal margin strongly convex; proximal lobe with well sclerotized caudal margin bearing about 4 stout bristles plus 4–5 smaller submarginal or lateral bristles; distal lobe broadly rounded apically, with 14–16 small bristles; sinus deeply concave. Aedeagal apodeme long, narrow, with apical appendage, proximal spur. Lateral lobes (L.L) well developed. Median dorsal lobe (M.D.L.) with apex subacuminate, caudal margin sinuate. Crochet (CR.) finger-like, with dorsal margin almost straight, ventral margin strongly concave. Armature of sclerotized sheath of inner tube (A.I.T.) and apex of sclerotic inner tube (A.S.I.) both hook-like. Penis rods extend beyond aedeagal apodeme, not coiled.

Plesiotype ♂ ex nest (Coll. No. CP 284); Cerro Potosi, Neuvo Leon, Mexico, 3200 m elevation; 22.IV.1964; collected by V. J. Tipton et al. Additional material as follows: 23♀♀, 19♂♂ ex *Thomomys umbrinus analogus*, 3040–3810 m, IV.1964; 1♀ ex *Mustela frenata*, 3220 m, V.1964; 15♀♀, 4♂♂ ex (2) nests, 2900–3050 m, IV.1964; collected by V. J. Tipton et al.

Remarks: All specimens, regardless of host, agree in details of the genitalia. However, there is an unusual amount of variation in the chaeotaxy of the head, thorax and abdomen. This is especially true among specimens collected from nests. It has occurred to us that *Foxella mexicana* may be a hybrid of *Foxella ignota* and *Foxella hoogstraali* since Cerro Potosi appears to represent a transitional area where species characteristic of southern Mexico and Central America meet species of North America. Additional collecting and laboratory rearing of these species will be required to confirm our suspicion.

Both male and female specimens are deposited in collections of the U. S. National Museum; British Museum (Natural History); Canadian National Collection; Rocky Mountain Laboratory at Hamilton, Montana; Escuela Nacional de Ciencias Biologicas (I. P.N.), Mexico, D. F.; Brigham Young University, Provo, Utah; Gorgas Memoral Laboratory, Panama and in the collections of Robert Traub and the senior author.

Table 1. Frequency distribution of small mammals (males vs females) on Cerro Potosi with different numbers of the flea, *Pleochaetis aztecus*.

HOST	*Peromyscus melanotis*		*Peromyscus difficilis*		*Peromyscus* species		*Microtus mexicanus*		*Neotoma albigula*		*Sorex milleri*		*Mus musculus*	
Sex of Host	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂
Total Number of Hosts	386	578	88	107	6	25	67	77	14	9	12	14	1	1
Number of Negative Hosts	152	206	81	84	1	11	62	69	12	8	11	13	0	1
Percent of Total	39.17	35.71	92.04	78.5	16.6	44	90.79	89.61	85.71	88.88	91.66	92.85	0	100.0
Fleas per Host														
1	71	101	5	14	1	6	4	5	2	0	1	1	1	0
2	50	67	1	2	0	3	1	3	0	1	0	0	0	0
3	22	56	0	2	2	2								
4	23	31	0	3	0	0								
5	12	26	0	0	0	0								
6	14	19	0	1	0	2								
7	8	18	0	1	0	0								
8	3	11	0	0	0	1								
9	5	9												
10	7	4												
11	2	5												
12	3	6												
13	2	3												
14	1	3			2	0								
15	1	1												
16	4	2												
17	2	4												
18	1	2												
19	0	0												
20	0	1												
21	0	1												
22	0	0												
23	0	1												
24	0	0												
25	1	0												
26	0	0												
27	1	0												
28	0	0												
29	1	0												
30	0	0												
Total Hosts with Fleas	234	371	7	23	5	14	5	8	2	1	1	1	1	0
Total Fleas	978	1529	28	49	35	38	6	11	2	2	1	1	1	0
Average Number of Fleas per Positive Host	4.18	4.11	4.0	2.13	7.0	2.71	1.20	1.37	1	2	1	1	1	0
Average Number of Fleas – – All Hosts	2.53	2.64	0.32	0.45	5.83	1.52	0.09	0.15	0.15	0.20	0.07	0.06	1	0

Table 2. Frequency distribution of small mammals (spring vs fall) on Cerro Potosi with different numbers of the flea, *Pleochaetis aztecus*.

Host	*Peromyscus melanotis*		*Peromyscus difficilis*		*Peromyscus* species		*Microtus mexicanus*		*Neotoma albigula*		*Sorex milleri*		*Mus musculus*	
Spring/Fall	S	F	S	F	S	F	S	F	S	F	S	F	S	F
Total Number of Hosts	376	589	129	66	31	0	52	93	17	6	10	18	2	0
Number of Negative Hosts	99	261	104	61	12	0	45	87	15	5	9	17	1	0
Percent of Total	26.33	53.37	80.54	85.75	38.71	0	87.64	93.55	88.23	83.33	90.0	94.4	50	0
Fleas per Host														
1	59	113	15	4	7	0	5	4	1	1	1	1	1	0
2	34	83	3	0	3	0	2	2	1	0				
3	37	41	1	1	4	0								
4	26	28	3	0	0	0								
5	25	13	0	0	0	0								
6	17	16	1	0	2	0								
7	12	14	1	0	0	0								
8	11	3	0	0	1	0								
9	11	3												
10	7	4												
11	5	2												
12	6	3												
13	4	1												
14	3	1			2	0								
15	1	1												
16	6	0												
17	4	2												
18	3	0												
19	0	0												
20	1	0												
21	1	0	1	0										
22	0	0												
23	1	0												
24	0	0												
25	1	0												
26	0	0												
27	1	0												
28	0	0												
29	1													
30														
Total Hosts with Fleas	277	328	25	5	19	0	7	6	2	1	1	1	1	0
Total Fleas	1509	998	70	7	73	0	9	8	3	1	1	1	1	0
Average Number of Fleas per Positive Host	5.45	3.03	2.80	1.40	3.84	0	1.28	1.33	1.50	1	1	1	1	0
Average Number of Fleas -- All Hosts	4.01	1.69	0.54	0.10	2.35	0	0.21	0.09	0.22	0.16	0.12	0.05	0.05	0

COMMENTS ON HOST-PARASITE RELATIONSHIPS

Jameson & Brennan (1957) have discussed the influence of environmental factors on the occurrence of ectoparasites. They contend that congeneric species are ecologically separated and thus do not compete. In a small geographic area (Cerro Potosi) we have collected 4 distinct populations (species?) of *Pleochaetis* from 3 host species. Two of the populations are associated with *Peromyscus melanotis*. Since we are not completely aware of the range of environmental factors involved or the seasonal distribution of each, we can only speculate about the degree of competition between the 2 populations, but we suspect that it is minimal (see chart: Occurrence of *P. aztecus* and *P. sibynus* on *Peromyscus melanotis* according to season, elevation and sex of host).

Initially we considered the sex of the host to be a significant factor in the distribution of *P. aztecus*. However, a study of the frequency distribution of this flea on male versus female hosts (*P. melanotis*) did not confirm our suspicion (Tables 1, 2). On the contrary, when these data are plotted on log x probability paper (see fig. 47a) the straight line relationship between male and female hosts indicates that sex of host exerts very little influence on the distribution of *P. aztecus*. When the procedure is duplicated but using season (spring versus fall) rather than sex of host, the 2 lines are nearly parallel but widely separated (see fig. 47b) indicating that season is a significant factor in the distribution of *P. aztecus*, 1 of the 2 species of *Pleochaetis* associated with *P. melanotis*. However, change in season reflects not only changes in ambient conditions but changes in the mat-

Table 3. Influence of sex of host and season on occurrence of Fleas on three species of Rodents.

Host Species	Spring		Fall							
	Total		Immatures		Adults				Totals	
	♂	♀	♂	♀	♂	♀N	♀L	♀P	♂	♀
Peromyscus melanotis	236	139	247	126	95	37	27	58	342	248
Number positive	207	115	161	80	75	26	15	46	236	167
Percent positive	87.34	82.73	65.14	63.49	78.94	89.65	51.72	77.96	96.00	67.30
Total Fleas	1337	801	511	288	347	79	43	193	858	603
Flea Index	6.46	6.96	3.17	3.60	4.62	3.03	2.86	4.20	3.63	3.61
Peromyscus difficilis	77	52	14	8	16	7	6	15	30	36
Number positive	59	25	5	4	13	2	2	5	18	13
Percent positive	76.62	48.07	35.71	50.00	81.25	28.57	33.33	33.33	60.00	36.11
Total Fleas	205	85	5	4	56	5	3	14	61	26
Flea Index	3.47	3.40	1.00	1.00	4.30	2.50	1.50	2.80	3.38	2.00
Microtus mexicanus subsimus	28	23	18	15	31	6	1	22	49	44
Number positive	18	17	10	6	23	4	0	11	33	21
Percent positive	64.28	73.91	55.55	40.00	74.19	66.60	000.00	50.00	67.34	47.72
Total Fleas	85	95	27	18	89	8	0	40	116	66
Flea Index	4.72	5.58	2.70	3.00	3.87	2.00	000.00	3.63	3.51	3.14

Legend: N=Normal L=Lactating P=Pregnant

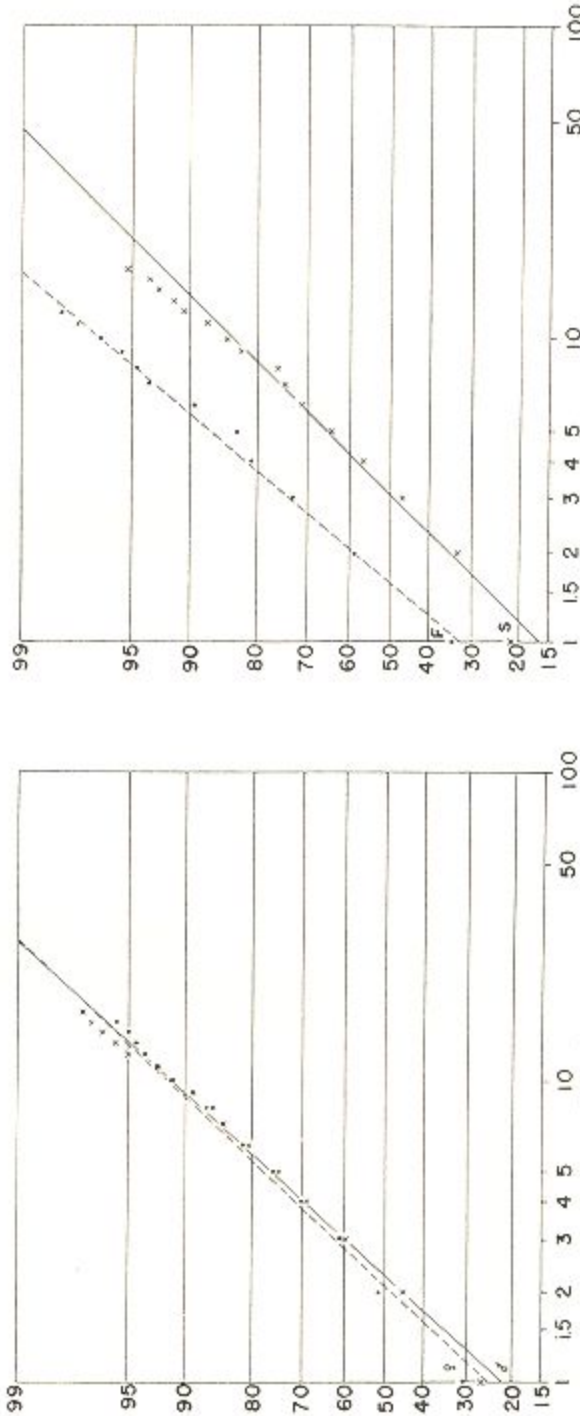


Fig. 47. Distribution of *Pleochaetis azteeus* on *Peromyscus melanotis* at Cerro Potosi showing the accumulated percentage of mice, on a probability scale, plotted against the number of fleas per mouse on a logarathmic scale. 47a, Lines ♀ and ♂ represent a straight line relationship between female and male hosts. 47b, Lines F and S represent a straight line relationship between hosts collected in the fall and hosts collected in the spring.

Table 4. Flea index and percent of hosts parasitized according to sex of host.

	Female Hosts					Male hosts					Totals				
	TOT	POS	Percent POS	FLS	IND	TOT	POS	Percent POS	FLS	IND	TOT	POS	Percent POS	FLS	IND
Peromyscus melanotis	387	282	73.05	1404	4.97	578	443	76.50	2195	4.95	965	725	75.12	3599	4.96
Peromyscus difficilis	88	38	43.18	111	2.90	107	77	71.86	266	3.45	195	115	63.63	377	3.27
Peromyscus species	6	5	83.30	73	14.60	25	23	92.00	88	3.82	31	28	90.30	161	5.39
Microtus mexicanus	67	38	56.70	161	4.23	77	51	66.20	201	3.94	144	90	62.06	362	4.02
Sorex milleri	12	2	13.30	3	1.50	14	3	23.00	4	1.33	26	5	17.85	7	1.40
Neotoma albigula	14	7	50.00	16	2.28	9	8	88.80	38	4.75	23	15	65.21	54	3.60
Thomomys umbrinus	8	7	87.50	50	7.14	7	7	100.00	83	11.85	15	14	93.33	133	9.50
Cynomys mexicanus[a]	7	5	71.40	51	10.20	7	6	85.70	127	21.10	17	14	82.30	229	16.35
Citellus spilosoma	1	0	—	0	0.00	2	1	—	1	1.00	3	1	—	1	1.00
Sciurus alleni	1	1	—	1	1.00	2	1	—	9	9.00	3	2	—	10	5.00
Sylvilagus floridanus[a]	2	2	—	21	10.50	1	0	—	0	0.00	4	3	—	30	10.00
Reithrodontomys fulvescens	0	0	—	0	0.00	2	2	—	2	1.00	2	2	—	2	1.00
Mus musculus	1	1	—	3	3.00	1	0	—	0	0.00	2	1	—	3	3.00
Citellus variegatus	1	1	—	8	8.00	1	1	—	18	18.00	2	2	—	26	13.00
Perognathus nelsoni	1	0	—	0	0.00	1	0	—	0	0.00	2	0	—	0	0.00
Citellus mexicanus[a]	0	0	—	0	0.00	1	1	—	1	1.00	2	1	—	1	1.00
Mustela frenata	1	1	—	7	7.00	0	0	—	0	0.00	1	1	—	7	7.00
Man	0	0	—	0	0.00	2	2	—	7	3.50	2	2	—	7	3.50
TOTAL	597	390	—	1909	4.88	837	626	—	3040	4.86	1439	1021	70.90	5009	4.90

[a] some specimens sex unknown

ing cycle of the hosts as well. For example, almost all of the host specimens collected in the spring were adult specimens, whereas in the fall, 72.2% of the females were immature specimens. In the spring the percentage of positive adult male hosts was essentially the same as the percentage of total hosts positive. Again, in the spring the flea index for adult male hosts was similar to that for all hosts. However, in the fall the percentage of positive adult male hosts was higher than the percentage of positive total hosts (65.26% vs 55.60%). In addition, the flea index for positive adult male hosts was higher than that for all positive hosts (3.88 vs 3.04). Table 3 gives the flea indices for adult and immature male hosts and immature, pregnant, lactating and normal female hosts. The flea indices on pregnant female mice (*P. melanotis*, *P. difficilis* and *M. mexicanus subsimus*) were considerably higher than on normal adult or lactating female mice.

Information presented in Table 4 indicates that flea indices are essentially the same for male and female hosts among small rodents. On larger rodents, such as prairie dogs and gophers, male hosts generally have a higher flea index. This may be a reflection of a more or less continuous breeding cycle among small rodents versus a seasonal breeding cycle among the larger rodents.

Table 5 shows the influence of elevation on the occurrence of fleas on the 3 rodent hosts most frequently encountered in our trapping. The optimum elevation for hosts and their flea parasites is essentially the same and is above 3050 m. *P. melanotis* is most abun-

Table 5. Influence of elevation on occurrence of fleas on three species of rodents elevations in thousands of feet (meters in parentheses).

HOST	6–7 (1.8–2.1)	7–8 (2.1–2.4)	8–9 (2.4–2.7)	9–10 (2.7–3.1)	10–11 (3.1–3.4)	11–12 (3.4–3.7)	12–12.5 (3.7–3.8)
Peromyscus melanotis			2	17	725	84	137
Positive Hosts			0	10	533	74	108
Percent Positive Host			0.00	58.82	73.51	88.09	78.83
Total Fleas			0	30.00	2381	553	635
Flea Index			0.00	3.00	4.46	7.47	5.88
Peromyscus difficilis difficilis	1	25	41	55	68	5	0
Positive Hosts	1	10	21	34	47	2	0
Percent Positive Host	100	40.00	51.21	61.80	69.11	40.00	0.00
Total Fleas	1	33	58	81	174	31	0
Flea Index	1	3.30	2.76	2.38	3.70	15.50	0.00
Microtus mexicanus subsimus			1	5	111	6	22
Positive Hosts			1	4	72	3	10
Percent Positive Hosts			100.00	80.00	65.76	50.00	45.45
Total Fleas			2	12	313	20	16
Flea Index			2.00	3.00	4.28	6.66	1.60

dant between 3200–3500 m elevation and the habitat at this elevation is probably more suitable for nesting because of abundant plant cover compared with that above 3660 m. The low flea index (1.66) on male hosts from 2740–3050 m elevation compared with the high index (8.62) on female hosts from 3350–3660 m elevation in the spring provides evidence that elevation is an important ecological factor influencing the distribution of fleas. Undoubtedly, there is a multiplicity of factors acting in combination to determine the abundance and species composition of fleas on a given host at a particular time.

Wenzel & Tipton (1966) suggested that balanced polymorphism or broad adaptive genetic variability is characteristic of flea species that are able to survive on a variety of hosts. If this is so, one might expect that this would be expressed phenotypically as well. A comparison of the flea faunae of *Cynomys mexicanus* and *Peromyscus melanotis* strengthens this postulate. There were 2 flea species associated with *C. mexicanus*, while there were 15 flea species associated with *P. melanotis*. The flea index for the former was over 16 but slightly less than 5 for the latter. There was little intraspecific variation in the samples of the 2 species collected from *C. mexicanus* but considerable variation in the several populations (species) on *P. melanotis* and especially in the genera *Pleochaetis* and *Jellisonia*. *C. mexicanus* belongs to a somewhat depauperate biological community characteristic of xeric areas, whereas *P. melanotis* belongs to a community associated with climax vegetation and with a correspondingly richer fauna. *C. mexicanus* is more ecologically restricted and is, therefore, less ubiquitious than *P. melanotis*. *P. melanotis* probably represents the optimum host for most of the 15 species we found on it. Only 1 species, *Malareus euphorbi*, was restricted to *P. melanotis* alone, and the other 14 species were promiscuous in varying degrees. *Pulex simulans*, though collected from several hosts by other workers in other geographical areas, may not be as promiscuous as records indicate. We suggest that *C. mexicanus* is the optimum host and that occurrence of this flea on carnivores is but a temporary association. *Opisocrostis hirsutus* has a wide geographic range but essentially is restricted to prairie dogs.

Table 6. Relative abundance of each flea species associated with each host.

Fleas on *Peromyscus melanotis*

Positive Hosts: 725
Percent Positive: 75.13
Negative Hosts: 241
Total Hosts: 965
Total Fleas: 3599

	Rodents with Fleas		Fleas	
	Number "A"	Percent "B"	Number "C"	Percent "D"
Pleochaetis aztecus	605	83.44	2507	69.66
Pleochaetis sibynus	287	39.57	602	16.73
Stenoponia ponera	149	20.55	222	6.17
Epitedia wenmanni	101	13.93	122	3.39
Strepsylla species	33	4.55	42	1.17
Ctenophthalmus pseudagyrtes	22	3.03	25	0.69
Pleochaetis species	4	0.55	20	0.55

Table 6 (Continued)

Hystrichopsylla species	17	2.34	17	0.47
Malareus euphorbi	8	1.10	12	0.33
Rhadinopsylla mexicana	8	1.10	12	0.33
Peromyscopsylla hesperomys adelpha	5	0.68	7	0.19
Pleochaetis asetus	6	0.82	6	0.17
Orchopeas neotomae	2	0.27	2	0.05
Rhadinopsylla fraterna	1	0.13	1	0.03
Foxella ignota	1	0.13	1	0.03
Unknown	1	0.13	1	0.03
		Total:	3599	99.99

Fleas on *Peromyscus difficilis difficilis*
Positive Hosts: 115
Percent Positive: 58.97
Negative Hosts: 80
Total Hosts: 195
Total Fleas: 377

	Rodents with Fleas		Fleas	
	Number "A"	Percent "B"	Number "C"	Percent "D"
Pleochaetis sibynus	96	84.20	216	57.14
Pleochaetis aztecus	30	26.30	77	20.37
Stenoponia ponera	20	17.50	29	7.67
Jellisonia hayesi	15	13.10	23	6.08
Strepsylla species	7	6.10	8	2.12
Epitedia wenmanni	5	4.38	6	1.59
Pleochaetis asetus	2	1.75	5	1.32
Ctenophthalmus pseudagyrtes	5	4.30	5	1.32
Hystrichopsylla species	1	0.90	4	1.06
Rhadinopsylla mexicana	3	2.60	3	0.79
Damaged				0.53
		Total:	377	99.99

Fleas on *Microtus mexicanus subsimus*
Positive Hosts: 90
Percent Positive: 62.06
Negative Hosts: 55
Total Hosts: 145
Total Fleas: 363

	Rodents with Fleas		Fleas	
	Number "A"	Percent "B"	Number "C"	Percent "D"
Pleochaetis asetus	64	71.10	204	56.20
Ctenophthalmus pseudagyrtes	46	51.10	111	30.60
Epitedia wenmanni	15	16.60	22	6.06
Pleochaetis aztecus	14	15.50	17	4.68
Pleochaetis sibnyus	4	4.40	4	1.10
Stenoponia ponera	2	2.20	2	0.55
Strepsylla species	1	1.10	1	0.27
Rhadinopsylla mexicana	1	1.10	1	0.27
Pulex simulans	1	1.10	1	0.27
		Total:	363	100.00

Table 6 (Continued)

Fleas on *Neotoma albigula leucodon*
Positive Hosts: 15
Percent Positive: 65.21
Negative Hosts: 8
Total Hosts: 23
Total Fleas: 54

	Rodents with Fleas Number "A"	Rodents with Fleas Percent "B"	Fleas Number "C"	Fleas Percent "D"
Pleochaetis sibynus	11	73.33	18	33.33
Orchopeas neotomae	6	40.00	17	31.50
Anomiopsyllus nidiophilus, n. sp.	4	26.66	12	22.22
Pleochaetis aztecus	3	20.00	4	7.40
Hystrichopsylla species	1	6.66	2	3.70
Rhadinopsylla mexicana	1	6.66	1	1.85
		Total:	54	100.00

Fleas on *Thomomys umbrinus*
Positive Hosts: 14
Percent Positive: 93.33
Negative Hosts: 1
Total Hosts: 15
Total Fleas: 133

	Rodents with Fleas Number "A"	Rodents with Fleas Percent "B"	Fleas Number "C"	Fleas Percent "D"
Foxella ignota	10	71.40	91	68.40
Foxella mexicana	13	92.85	42	31.60
		Total:	133	100.00

Fleas on *Cynomys mexicanus*
Positive Hosts: 14
Percent Positive: 82.35
Negative Hosts: 3
Total Hosts: 17
Total Fleas: 229

Pulex simulans	11	78.57	129	56.33
Opisocrostis hirsutus	10	71.42	100	43.66
		Total:	229	99.99

Fleas on *Sorex milleri*
Positive Hosts: 5
Percent Positive: 17.85
Negative Hosts: 23
Total Hosts: 28
Total Fleas: 7

Corrodopsylla curvata	3	60.00	4	57.14
Pleochaentis aztecus	2	40.00	2	28.57
Ctenophthalmus pseudagyrtes	1	20.00	1	14.28
		Total:	7	99.99

Table 6 (Continued)

Fleas in Rodent Nests
Positive Nests: 18
Percent Positive: 40.00
Negative Nests: 27
Total Nests: 45
Total Fleas: 399

	Nests with Fleas		Fleas	
	Number "A"	Percent "B"	Number "C"	Percent "D"
Anomiopsyllus nidiophilus, n. sp.	1	5.56	159	39.84
Pleochaetis sibynus	6	33.33	56	14.03
Ctenophthalmus pseudagyrtes	7	38.89	36	9.02
Pleochaetis aztecus	7	38.89	29	7.27
Epitedia wenmanni	7	38.89	29	7.27
Foxella mexicana	2	11.11	20	5.01
Polygenis gwynni	4	22.22	16	4.01
Hystrichopsylla species	6	33.33	13	3.26
Foxella ignota	2	11.11	12	3.01
Strepsylla species	3	16.67	9	2.26
Rhadinopsylla mexicana	1	5.56	5	1.25
Pleochaetis species	1	5.56	4	1.00
Rhadinopsylla fraterna	2	11.11	3	0.75
Pleochaetis asetus	2	11.11	2	0.50
Orchopeas howardi	1	5.56	2	0.50
Stenoponia ponera	1	5.56	1	0.25
Malareus sp.	1	5.56	1	0.25
Opisodasys species	1	5.56	1	0.25
Phalacropsylla hamata, n. sp.	1	5.56	1	0.25
		Total:	399	99.98

* Collected only in nests

In Table 6 the first figure in column A opposite *Pleochaetis aztecus* indicates that *P. aztecus* was collected from 605 specimens of *P. melanotis*. The number 605 is 83.44% (column B) of the 725 specimens of *P. melanotis* positive for fleas. Of the total fleas (3599) collected from *P. melanotis* there were 2507 specimens of *P. aztecus* (column C) which is 69.66% of the total (column D).

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